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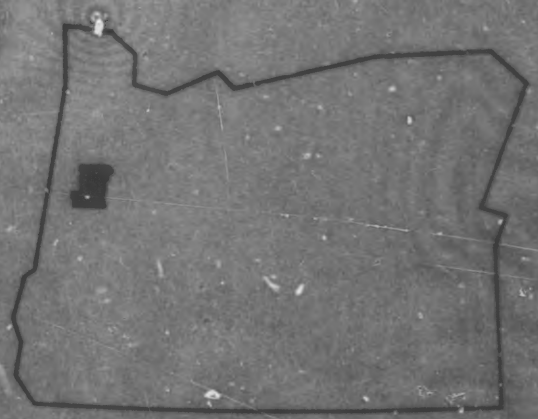
FLOOD INSURANCE STUDY

ORIGINAL



BENTON COUNTY, OREGON
UNINCORPORATED AREAS

AUGUST 5, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 410008

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Exhibit 2 - Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

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1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the unincorporated areas of Benton County, Oregon, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers (COE), Portland District, for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. H-18-78, Project Order No. 21. This study was completed in December 1980.

1.3 Coordination

The initial coordination meeting was held February 17, 1978, with representatives of FEMA, Benton County, and the study contractor to identify stream reaches to be studied, explain study concepts, identify data sources, and establish communication and coordination procedures.

An intermediate coordination meeting was held in the Benton County Courthouse on May 21, 1981, to allow local officials to review plan and profile drawings showing water-surface profiles, floodway delineations, and flooded-area outlines.

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The final community coordination meeting was held on July 22, 1985, and attended by representatives of FEMA, the study contractor, and the community. All problems and concerns raised at that meeting have been addressed in this study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Benton County, Oregon. The area of study is shown on the Vicinity Map (Figure 1).

Areas not included in this study are the Cities of Corvallis, Philomath, Monroe, and Albany, the Town of Adair Village, and the Adair Air Force Station, Oregon.

The following streams in Benton County were studied by detailed methods:

Willamette River for the entire length affecting Benton County

Marys River from the City of Corvallis corporate limits to U.S. Highway 20 west of the City of Philomath

North Fork Alsea River from the western boundary of Section 1 of T. 14 S., R. 8 W., upstream 1.5 miles through the community of Alsea

Newton Creek from its mouth to West Hills Road

Oak Creek from the City of Corvallis corporate limits to the Southern Pacific Railroad

Soap Creek from the State game refuge upstream 1.5 miles

Frazier Creek from sump area east of U.S. Highway 99 West upstream to Crescent Valley Drive

Jackson Creek from its confluence with Frazier Creek upstream to Crescent Valley Drive

Millrace from the City of Corvallis corporate limits to its divergence from Marys River

Millrace Overflow from its confluence with the Willamette River to the City of Corvallis corporate limits

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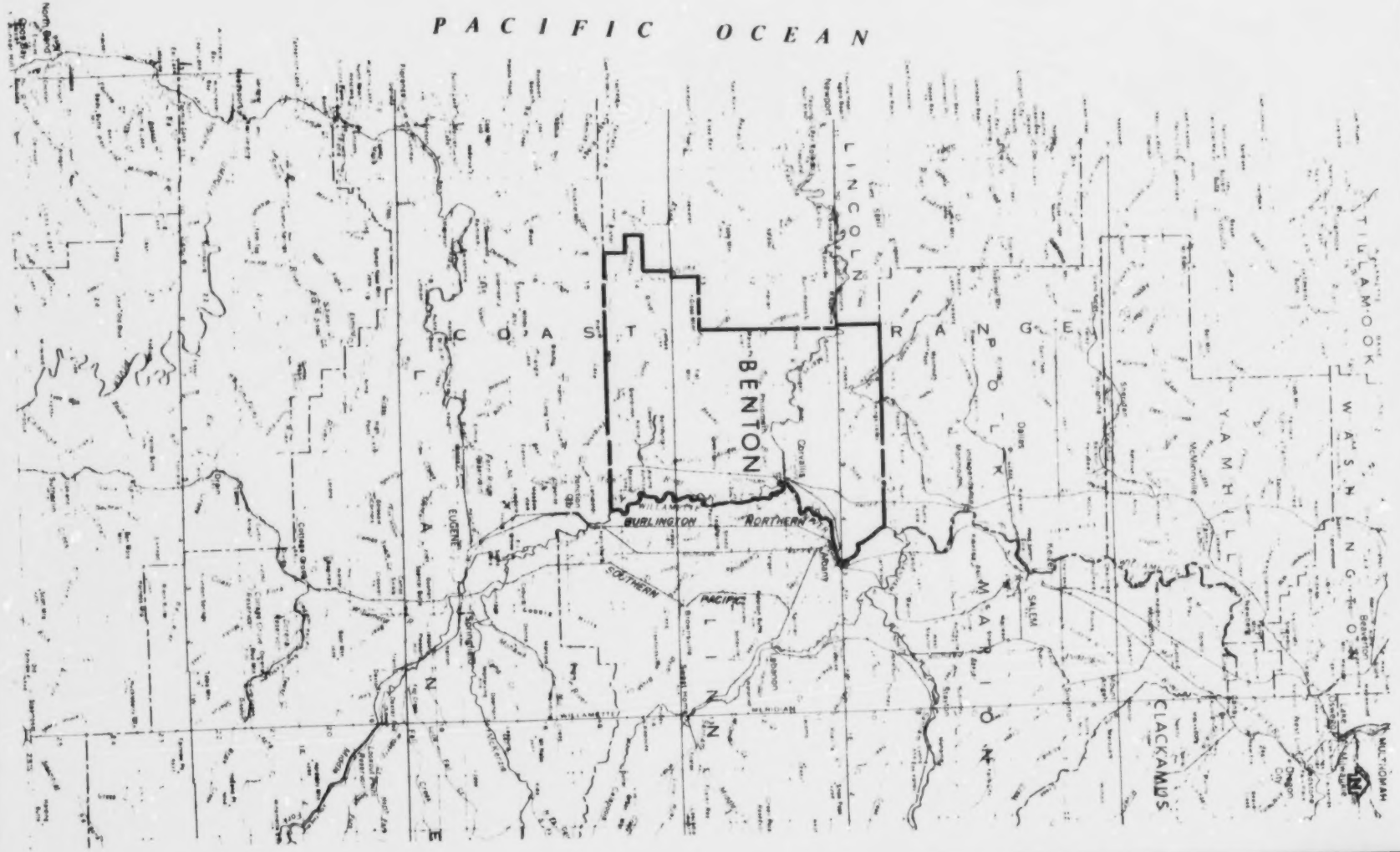

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

16 0 16 32 48 MILES

VICINITY MAP

FIGURE 1

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Stewart Slough from its mouth upstream to the City of Corvallis eastern corporate limits and 0.08 mile upstream from the City of Corvallis northern corporate limits

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1990.

Approximate analytical methods were used to study Greasy Creek from its mouth upstream 2.5 miles, North and South Fork Squaw Creek from their confluence upstream to 53rd Street, and East Newton Creek from its confluence with Newton Creek upstream to the log pond, as well as parts of the Newton Creek, Marys River, and Alsea River.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Benton County.

2.2 Community Description

Benton County is located in west-central Oregon. It is bordered to the north by Polk County, to the south by Lane County, to the west by Lincoln County, and to the east by Linn County and the Willamette River. Benton County has experienced moderate growth during the last decade. The population increased from 18,629 in 1940 to 68,800 in 1978 (Reference 1). The population was estimated to be 68,211 in 1980 (Reference 2). Most of this increase has occurred in incorporated cities within the county.

All streams studied, except for the Alsea River, are a part of the Willamette River basin. The Willamette River forms at the confluence of its Coast and Middle Forks approximately 5 miles upstream of Eugene, Oregon. The Coast Fork originates in the Calapooia Mountains, whereas the Middle Fork originates in the Cascade Mountains. At Eugene, the Willamette River emerges from the foothills and flows northerly through the Willamette Valley. Upstream from Corvallis, the Willamette River drains approximately 4,400 square miles of mostly mountainous timberland.

The Marys River originates in the Coast Range and flows about 45 miles easterly and then northeasterly to meet the Willamette River in southern Corvallis. The 299-square-mile drainage basin is roughly triangular.

The Alsea River originates in the Coast Range and flows westerly into the Pacific Ocean at Waldport. Within Benton County, the Alsea River drains mostly timberlands in the Coast Range.

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The other streams studied are tributaries to either the Willamette River or Marys River. The drainage areas of these tributaries are less than 13 square miles. Many of these tributaries are located in the flat, wide Willamette River Valley.

Benton County's economy is keyed closely to Oregon State University, a major employer in the area. Other industries in the area are forest products, electronics, and rye seed production.

Benton County's climate consists of warm, dry summers and mild, wet winters. Temperatures range from an average January minimum of 34°F in the Willamette River Valley to an average July maximum of 81°F (Reference 3). Precipitation varies over the county, depending on elevation and location. In the Willamette River Valley, where the majority of the county residents live, the average annual precipitation is 37 inches, with approximately 75 percent occurring between November and March. Average annual snowfall is 7 inches, with most occurring in January (Reference 4).

Vegetation in the county varies from timber in the higher elevations to agricultural species in the lower valley areas. Soils in the mountainous areas range from light soils to sands and gravels. In the valley areas Willamette soil types predominate. Soils in these areas vary from moderate to poor permeability, and in wet winter months may have a water table that in some areas comes within 10 inches or less of the ground surface.

Residential development within the flood plain areas of unincorporated Benton County is minimal. However, moderately dense residential development in areas such as North Albany and South Corvallis is subject to flooding.

2.3 Principal Flood Problems

Flooding in Benton County is caused by intense rainfall from massive winter storms moving inland from the Pacific Ocean. This condition often results in simultaneous flooding on all streams in the study area. The greatest known flood on the Willamette River occurred in December 1861, before there was a stream-gaging network for recording flood heights. Discharges and crest elevations for large Willamette River floods at the U.S. Geological Survey (USGS) Albany gage (No. 14174000) from 1941 to 1978 are listed in Table 1. The 1964 flood was a result of unusually intense precipitation on a frozen topsoil, augmented by snowmelt in the mountains and valley. Without upstream regulation, the 1964 flood would have been the largest flood of this century, with a peak discharge of 320,000 cubic feet per second (cfs) at the Albany gage. However, upstream regulation reduced the peak discharge to 186,000 cfs (Reference 5). The 1964 flood had a recurrence interval of about 70 years (Reference 6). The most recent Willamette River flood occurred in December 1977 and had a recurrence interval of about 5 years at Albany.

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Table 1. Willamette River Floods Near Albany, Oregon

Date	Discharge (cfs)	Crest Elevation (feet)
January 2, 1943	218,000	202.9
December 30, 1945	206,000	202.2
December 16, 1946	138,000	197.9
January 8, 1948	185,000	201.1
January 20, 1953	174,000	200.4
February 12, 1961	165,000	199.9
December 24, 1964	186,000	201.1
December 16, 1977	87,700	192.1

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Two of the largest Marys River floods occurred in December 1964 and January 1974. Those floods had peak flows of 13,600 and 11,100 cfs, respectively, and recurrence intervals of about 35 and 15 years, respectively, at the USGS stream gage near Philomath (Reference 7). The 1964 flood was especially severe because Willamette River flooding backed water up the Marys River. The 1974 flood was caused by intense rainfall on frozen terrain at higher elevations. The Corvallis Water Bureau Gage, in the upper portion of the Marys River basin, recorded 4.42 inches of rainfall on January 15, 1974 (Reference 8).

A major Alsea River flood occurred in 1964. On the North Fork of the Alsea River at Alsea, Oregon, the peak floodflow for that event was 14,000 cfs. This event had a recurrence interval of about 90 years (Reference 9).

Little historical flood data are available for the remaining streams within the study area. However, December 1964 flood photographs show most tributaries of the Marys and Willamette Rivers flooding from backwater effects.

Flood damage caused by the 1964 flood in the unincorporated areas was limited primarily to agricultural lands. However, low-lying dwellings scattered along the Marys River, and residential developments near Stewart Lake and North Albany, suffered extensive damage. Figures 2, 3, and 4 show Benton County flooding in December 1964.

2.4 Flood Protection Measures

The COE operates eight flood-control storage projects upstream of the study area on major tributaries of the Willamette River. These projects, constructed from 1942 to 1968, control runoff from approximately 75 percent of the drainage area upstream of Benton County. In addition, many bank-protection projects have been constructed along the Willamette River in the study area. The protection projects are riprapped-bank projects that do not reduce flood levels. There are no flood-control structures on the Marys River, the Alsea River, or any of the small streams within the study area.

The county is using nonstructural measures to prevent future flood damage. The county has adopted a flood plain management ordinance as a basis for participating in the NFIP, which requires the evaluation of the flood hazard before allowing development in the flood plain.

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Figure 2. December 1964 Flood in South Corvallis, Looking East Toward Willamette River, Millrace in Foreground

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Figure 3. December 1964 Willamette River Flood, Approximately 12 Miles South of Corvallis, Looking East, With Norwood Island on Extreme Right, Old Long Tom River Across Foreground

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Figure 4. December 1964 Willamette River Flood, Looking East Approximately 12 Miles South of Corvallis; Long Tom River in Left Foreground

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3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Stream gage records for the Willamette River were statistically analyzed utilizing the standard log-Pearson Type III distribution as outlined by the Water Resources Council (Reference 10). Natural discharge-frequency curves (References 6 and 11) were developed for the USGS gages on the Willamette River at Albany (gage No. 14174000) and Harrisburg (gage No. 14166000) using data from 1893 to 1976. Regulated discharge-frequency curves were then prepared for each gage using flood-routing computations to take upstream storage projects into account. Between the gaging stations, Willamette River-regulated discharge values were derived based upon a ratio of change in drainage area.

Marys River stream gage records were statistically analyzed utilizing the standard log-Pearson Type III distribution (Reference 10). A discharge-frequency curve (Reference 7) was developed for the USGS gage on the Marys River (gage No. 14171000) near Philomath, using data from 1941 to 1975. Discharge values on the Marys River at the mouth were obtained using drainage area ratios in combination with storm-hydrograph routing.

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Alsea River discharge was determined at the Alsea gage (gage No. 14306100) utilizing a log-Pearson Type III distribution (Reference 10). Stream records from 1940 through 1968 were used in the analysis (Reference 9). For the remaining streams studied in detail, frequency-discharge values were based upon drainage area ratios and a correlation of streamflow records for Rock Creek and the Marys River USGS gage near Philomath.

Peak discharge-drainage area relationships for each stream studied in detail are shown in Table 2.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of flood elevations of the selected recurrence intervals.

Water-surface profiles for the portion of the Willamette River within Benton County, except for a reach at North Albany, were determined from hydraulic rating curves. Those curves were based on crest gages established in 1964 and high-water marks recorded at the crest gages. The remaining reach of the Willamette River through North Albany was analyzed using the COE HEC-2 step-backwater computer program (Reference 12).

Hydraulic analyses for the remaining streams studied in detail were performed using the COE HEC-2 step-backwater computer program (Reference 12). Cross sections are composites of data from City of Corvallis, City of Philomath, USGS, and COE topographic information (References 13, 14, 15, and 16) and COE field surveys. All bridges, dams, and culverts were field checked to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments on which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Hydraulic roughness values (Manning's "n") for the channel and overbanks were first estimated from field observation. The "n" values were then adjusted to match high-water marks where available. Tabulated "n" values are shown in Table 3 for all streams studied in detail using the HEC-2 computer model.

For all streams studied using the COE HEC-2 step-backwater computer program, starting water-surface elevations were obtained using normal-depth calculations. Flood profiles were drawn showing computed water-surface elevations for floods of selected recurrence intervals.

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Table 2. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Willamette River					
At USGS Albany Gage No. 14174000	4,840	117,000	172,000	200,000	272,000
At USGS Harrisburg Gage No. 14166000	3,420	81,000	107,000	123,000	182,000
Marys River					
Upstream of Millrace	299	13,200	18,300	20,500	26,000
At USGS Philomath Gage	159	10,700	15,400	17,700	23,400
Upstream of Confluence With Grassy Creek	120	8,200	11,700	13,200	17,200
North Fork Alsea River					
At West Boundary Section 1, T. 14 S., R. 8 W.	128	15,650	23,200	26,700	35,500
At North Fork Alsea River Alsea Gage	63	9,030	13,400	15,400	20,500
Newton Creek					
At Mouth	4.6	550	760	855	1,080
At U.S. Highway 20	3.6	430	600	680	855
Oak Creek					
At Mouth	13.4	1,595	2,210	2,495	3,140
Soap Creek					
At North Boundary Section 34, T. 10 S., R. 5 W.	10.3	1,300	--[1]	1,890	--[1]

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Table 2. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Frazier Creek					
At Mouth	6.7	800	1,115	1,250	1,585
Upstream of Confluence With Jackson Creek	4.2	500	695	780	985
At Crescent Valley Drive	1.7	200	275	310	395
Jackson Creek					
At Mouth	2.5	300	420	470	600
At Crescent Valley Drive	1.8	215	300	335	420
Millrace					
At Crystal Lake Drive	—[2]	370	1,350	1,810	3,200
Millrace Overflow					
At Mouth	--[1]	--[1]	190	320	1,[illegible]00
Stewart Slough	--[3]	300[4]	--[1]	500[4]	--[1]

[1]Discharge Not Available
[2]Overflow From Marys River
[3]Drainage Area Indeterminant
[4]Discharge Based on High-Water Marks

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Table 3. Hydraulic Roughness Values

Stream	Overbank	Channel
Willamette River	0.041 - 0.250	0.025 - 0.045
Marys River	0.100	0.050 - 0.084
North Fork Alsea River	0.070 - 0.120	0.046
Newton Creek	0.030 - 0.120	0.030 - 0.060
Oak Creek	0.070 - 0.130	0.040 - 0.110
Soap Creek	0.160	0.040 - 0.070
Frazier Creek	0.100 - 0.185	0.070 - 0.120
Jackson Creek	0.100 - 0.224	0.090
Millrace	0.070 - 0.130	0.040 - 0.110
Millrace Overflow	0.070 - 0.130	0.040 - 0.110
Stewart Slough	0.070 - 0.130	0.040 - 0.110

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The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Only the 10- and 100-year recurrence intervals have been computed for Soap Creek. The 50- and 500-year recurrence intervals were not within the scope of study.

Generally, the distances on the flood profiles correspond to distances measured along the centerline of the designated watercourses. For Millrace Overflow, however, the absence of a low-flow streambed necessitated use of distances measured along the centerline of the 100-year flow path. On the maps, this flow line, used to establish the respective profile distances, is delineated and labeled as a Profile Base Line.

Because of limitations of map scale and the use of established river miles, stream distances as depicted on the flood profiles may not always match those depicted on the maps.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps as noted in the paragraph that follows.

Flood plain boundaries for Oak Creek, Frazier Creek, Jackson Creek, Millrace, Millrace Overflow, and segments of the Willamette and Marys Rivers in the vicinity of Corvallis were mapped using interpolated data from City of Corvallis topographic maps at a scale of

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1:2,400, with a contour interval of 2 feet (Reference 13). This information was then transferred to USGS 7.5-minute series topographic maps (Reference 15), enlarged to a scale of 1:4,800. Flood plain boundaries for Newton Creek were mapped using interpolated data from City of Philomath topographic maps at a scale of 1:2,400, with a contour interval of 2 feet (Reference 14). This information was also transferred to USGS 7.5-minute series topographic maps enlarged to a scale of 1:4,800 (Reference 15). Flood plain boundaries for Soap Creek were mapped using interpolated cross sections from surveyed cross section data. This information was then transferred to an aerial photograph at a scale of 1:4,800. Flood plain boundaries for the North Fork Alsea River were mapped using COE topographic information at a scale of 1:4,800, with a contour interval of 5 feet (Reference 16). Flood plain boundaries for the Willamette and Marys Rivers outside the Corvallis area were mapped using USGS 7.5-minute series topographic maps enlarged to a scale of 1:4,800 (Reference 15).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year flood plain boundary is shown.

Flood plain boundaries for streams studied by approximate methods were delineated using topographic maps (References 13, 14, and 16), and elevations were established through approximate hydraulic calculations.

Approximate 100-year flood plain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Map (Reference 17).

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas,

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that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. At the request of the City of Corvallis, both 1.0-foot-increase and 0.2-foot-increase floodways were computed in the Corvallis Flood Insurance Study (Reference 18) for all streams containing a floodway, except for the Willamette River. For this study only the 1.0-foot-increase floodway is used. The 0.2-foot-increase floodway, where computed, is available on maps prepared by the study contractor. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 4).

No floodways were computed for Newton or Soap Creeks because they were not within the scope of this study.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 5.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Willamette River								
A[2]								
B	114.36	3,435/ 1,435[3]	43,320	4.6	193.6	193.6	194.2	0.6
C	115.11	4,020/ 3,750[3]	43,798	4.6	194.5	194.5	195.2	0.7
D	116.01	4,900/ 2,500[3]	51,244	3.9	195.9	195.9	196.4	0.5
E	116.99	3,369/ 2,790[3]	70,851	2.8	197.4	197.4	198.4	1.0
F	117.58	4,308/ 3,950[3]	80,883	2.5	198.8	198.8	199.8	1.0
G	118.27	3,639/ 3,260[3]	70,821	2.8	200.0	200.0	201.0	1.0
H	118.92	2,481/ 2,120[3]	44,263	4.5	201.0	201.0	202.0	1.0
I	120.99	5,460/ 1,790[3]	66,485	2.7	204.5	204.5	205.4	0.9
J-S[2]								

[1]Miles Above Mouth [2]Floodway Not Shown for These Cross Sections [3]Width/Width Within County Limits

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TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

WILLAMETTE RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Marys River								
A	8,521	1,100	10,302	1.8	223.5	223.5	224.0	0.5
B	10,351	900	13,795	1.3	223.8	223.8	224.3	0.5
C	11,771	900	12,431	1.5	223.9	223.9	224.5	0.6
D	12,391	1,065	14,606	1.2	224.0	224.0	224.6	0.6
E	13,611	575	5,813	3.5	224.3	224.3	225.0	0.7
F	15,411	920	7,197	2.8	225.2	225.2	226.0	0.8
G	17,371	1,590	10,383	2.0	225.9	225.9	226.7	0.8
H	21,621	1,593	12,016	1.7	227.0	227.0	228.0	1.0
I-T[3]								
U	59,938	1,322	5,902	3.0	258.0	258.0	258.3	0.3
V	64,540	1,262	4,116	4.3	262.4	262.4	263.3	0.9
W	65,310	1,440	7,991	2.2	263.2	263.2	264.2	1.0
X	68,790	961/ 856[2]	5,358	3.3	266.0	266.0	266.9	0.9
Y	70,310	603	4,109	4.3	268.5	268.5	269.4	0.9
Z	73,915	223	2,212	6.0	275.2	275.2	275.7	0.5

[1]Feet Above Mouth [2]Width/Width Within County Limits [3]Floodway Not Shown for These Cross Sections

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

MARYS RIVER

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
North Fork Alsea River								
A	0[1]	434	4,197	6.4	278.2	278.2	279.2	1.0
B	1,975[1]	689	6,393	4.2	281.5	281.5	282.5	1.0
C	4,740[1]	209	2,141	7.2	285.6	285.6	286.1	0.5
D	5,220[1]	249	2,765	5.6	286.9	286.9	287.2	0.3
E	7,060[1]	216	2,249	6.8	289.5	289.5	290.1	0.6
Oak Creek								
A	0.892[2]	710/160[3]	775	3.2	231.3	231.3	232.1	0.8
B	0.994[2]	80	625	4.0	233.2	233.2	234.2	1.0
C	1.028[2]	69	398	6.3	233.9	233.9	234.8	0.9

[1]Feet Above Downstream Limit of Detailed Study [2]Miles Above Mouth [3]Width/Width Within County Limits

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

NORTH FORK ALSEA RIVER-OAK CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Frazier Creek								
A	0.001	500	1,081	1.2	217.4	217.4	218.4	1.0
B	0.247	290	794	1.6	222.2	222.2	223.1	0.9
C	0.389	240	750	1.7	225.3	225.3	226.2	0.9
D	0.480	90	569	2.2	227.1	227.1	227.8	0.7
E	0.623	300	1,220	1.0	230.2	230.2	231.1	0.9
F	0.718	450	1,177	1.1	230.8	230.8	231.8	1.0
G	0.765	140	372	2.1	231.9	231.9	232.3	0.4
H	0.945	110	149	5.2	238.2	238.2	238.3	0.1
I	1.078	120	410	1.9	241.8	241.8	242.7	0.9
J	1.286	50	178	2.7	249.4	249.4	249.9	0.5
K	1.608	60	138	3.5	266.3	266.3	267.0	0.7
L	1.665	30	129	3.7	268.0	268.0	268.7	0.7
M	1.729	22	89	5.4	270.8	270.8	270.8	0.0
N	1.881	20	100	4.7	278.6	278.6	279.3	0.7
O	2.146	14	47	6.6	295.5	295.5	295.5	0.0
P	2.448	30	185	1.7	321.1	321.1	321.6	0.5

[1]Miles Above Sump Area East of U.S. Highway 99 West

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

FRAZIER CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Jackson Creek								
A	0.129	150	268	1.8	235.1	235.1	235.9	0.8
B	0.328	60	161	2.9	242.6	242.6	243.3	0.7
C	0.508	36	153	3.1	249.2	249.2	249.7	0.5
D	0.764	29	75	6.3	266.8	266.8	266.8	0.0
E	0.856	22	87	3.9	274.3	274.3	274.3	0.0
F	1.049	24	74	4.5	286.0	286.0	286.0	0.0
G	1.134	39	71	4.7	295.8	295.8	295.8	0.0
H	1.367	40	95	3.5	322.5	322.5	323.1	0.6
I	1.623	25	81	4.1	343.2	343.2	343.6	0.4

[1]Miles Above Mouth

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

JACKSON CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Millrace								
A	0.892	370	2,057	1.1	223.6	223.6	224.4	0.8
B	1.021	190	862	2.7	223.9	223.9	224.8	0.9
Millrace Overflow								
A	0.022	110/ 50[2]	461	0.1	221.3	216.2	217.1	0.9

[1]Miles Above Mouth [2]Width/Width Within County Limits

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

MILLRACE-MILLRACE OVERFLOW

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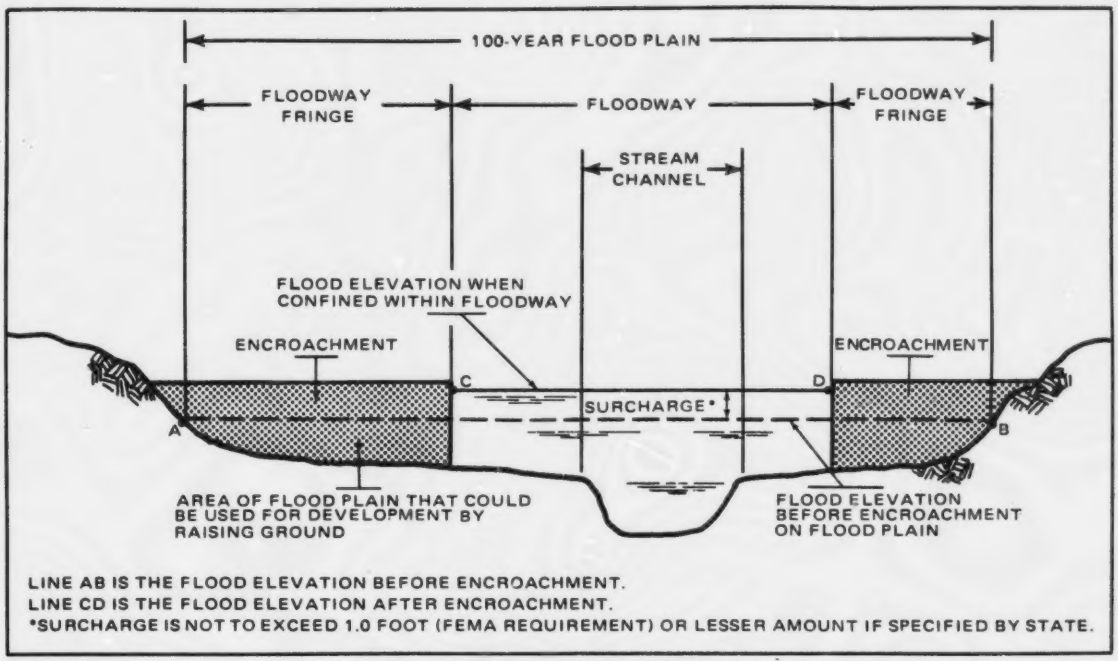
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 5. Floodway Schematic

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting Benton County.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This

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difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of Benton County are shown on the Flood Profiles (Exhibit 1) and summarized in Table 5.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for an FHF of 005 to a maximum of 30 for an FHF of 200 or greater.

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.

Zone AH: Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; base flood elevations are shown, but no FHFs are determined.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Willamette River							
Reach 1	0050,0175	-6.4	-1.8	3.6	065	A13	Varies - See Map
Reach 2	0080,0090, 0175	-5.3	-1.4	3.2	055	A11	Varies - See Map
Reach 3	0090,0175, 0250	-2.5	-0.7	2.1	025	A5	Varies - See Map
Marys River							
Reach 1	0090	-4.2	-1.0	2.3	040	A8	Varies - See Map
Reach 2	0067,0075, 0086,0090	-1.7	-0.4	0.9	015	A3	Varies - See Map
Reach 3	0067	-2.6	-0.7	1.6	025	A5	Varies - See Map
Alsea River							
Reach 1	0119,0138	-2.8	-0.8	1.7	030	A6	Varies - See Map
Newton Creek							
Reach 1	0067,0086	-1.2	-0.3	0.6	010	A2	Varies - See Map
Reach 2	0067	-0.6	-0.2	0.2	005	A1	Varies - See Map
Oak Creek							
Reach 1	0080	-1.1	-0.3	0.5	010	A2	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

WILLAMETTE RIVER-MARYS RIVER-ALSEA RIVER-NEWTON CREEK-OAK CREEK

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Soap Creek Reach 1	0050	-1.2	--[4]	--[4]	010	A2	Varies - See Map
Frazier Creek Reach 1	0080	-0.7	-0.2	0.4	005	A1	Varies - See Map
Shallow Flooding	0080	N/A	N/A	N/A	N/A	AH	217
Jackson Creek Reach 1	0080	-0.7	-0.2	0.4	005	A1	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

[4]50- and 500-Year Profiles Were Not Computed

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

SOAP CREEK-FRAZIER CREEK-JACKSON CREEK

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Zones A1-A3, A5, A6, A8, A11, and A13:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other local water-control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flood hazard; not subdivided.
Zone D:	Areas of undetermined, but possible flood hazard.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 5.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Benton County is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the NFIP.

6.0 OTHER STUDIES

In 1971, the COE prepared a Flood Plain Information (FPI) report for the Cities of Corvallis and Philomath (Reference 19). That report contains 100-year flood profiles for the Willamette and Marys Rivers. The FPI report for the City of Albany (Reference 20) also includes profiles for the Willamette River. The water-surface profiles in this study are higher than those shown in the FPI reports. The Willamette River profile is from 2 to 4 feet higher along the reach through Benton County. This difference is caused by an increase in the estimated discharge, a result

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of including additional years of streamflow records in the frequency analysis and correlating the amount of flood-control regulation in the study reach with other locations along the Willamette River. The Marys River 100-year flood profile in this report when compared with the FPI report profile is about 1 foot lower at the west edge of Corvallis, 2 feet higher near Bellfountain Road, and about the same height near the Highway 34 bridge. The differences in elevations are a result of additional years of streamflow records and more accurate hydraulic modeling.

Flood Insurance Studies have been prepared for the Cities of Corvallis, Philomath, Albany, and Millersburg (References 18, 21, 22, and 23, respectively) and Lincoln and Polk Counties (References 24 and 25, respectively). These studies are or will be in agreement with the data presented in this study. The City of Millersburg Flood Insurance Study does not include the more accurate hydraulic modeling for the Willamette River that has been employed for the other areas affected by the Willamette River. As a result, Willamette River 100-year elevations are approximately 2 feet higher in this study than in the City of Millersburg Flood Insurance Study. The City of Millersburg Flood Insurance Study will be revised.

A Flood Hazard Boundary Map has been prepared for the City of Monroe (Reference 26). The information presented on that map is in agreement with this study.

Flood Insurance Studies have also been prepared for Lane and Linn Counties, Oregon (References 27 and 28). Data presented in those studies match the information shown in this study.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Federal Regional Center, 130 228th Street, SW., Bothell, Washington 98021-9796.

8.0 BIBLIOGRAPHY AND REFERENCES

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19. U.S. Department of the Army, Corps of Engineers, Portland District, Flood Plain Information, Corvallis and Philomath, Oregon, March 1971

20. U.S. Department of the Army, Corps of Engineers, Portland District, Flood Plain Information, Albany, Oregon, 1971

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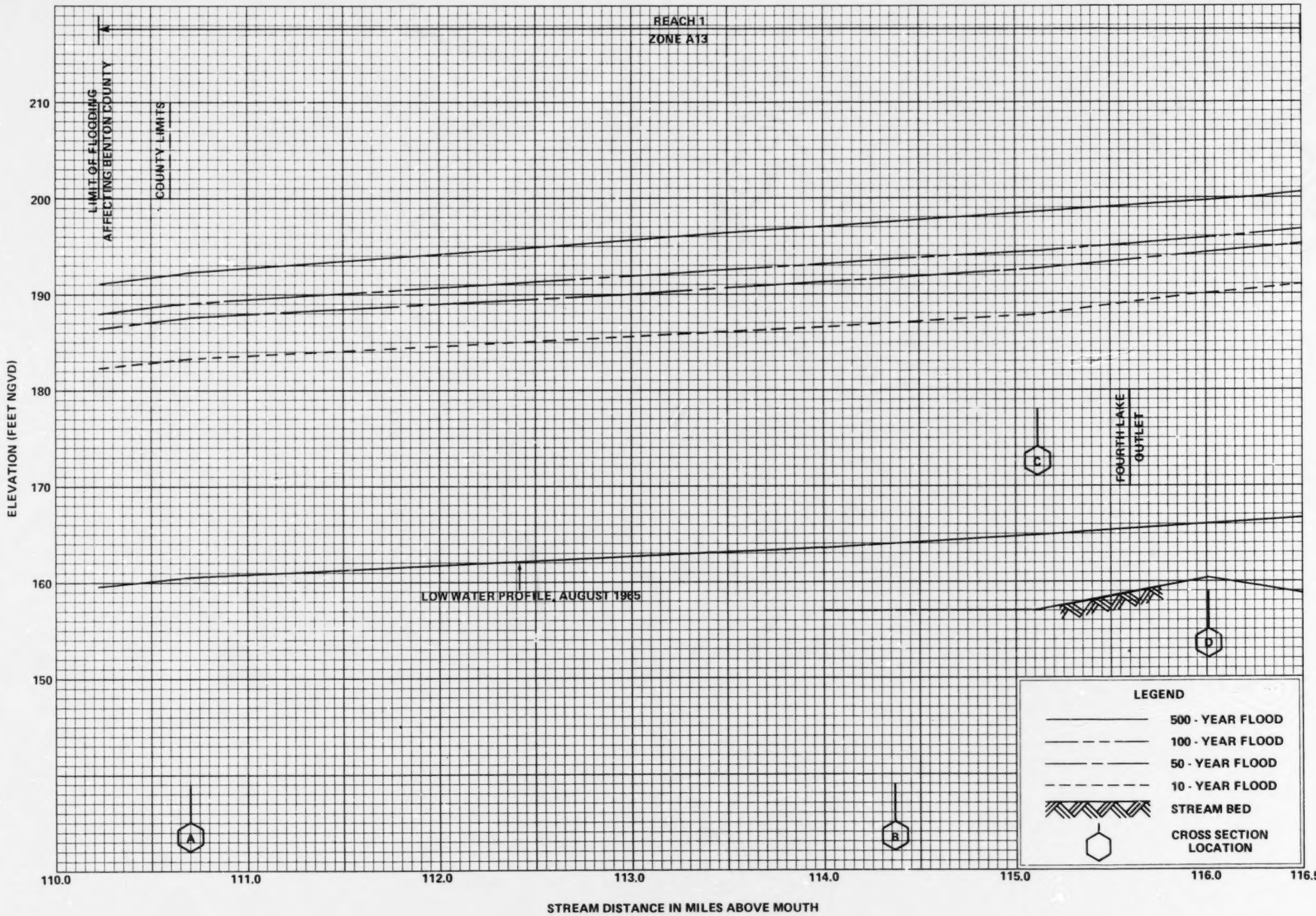

FLOOD PROFILES

WILLAMETTE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

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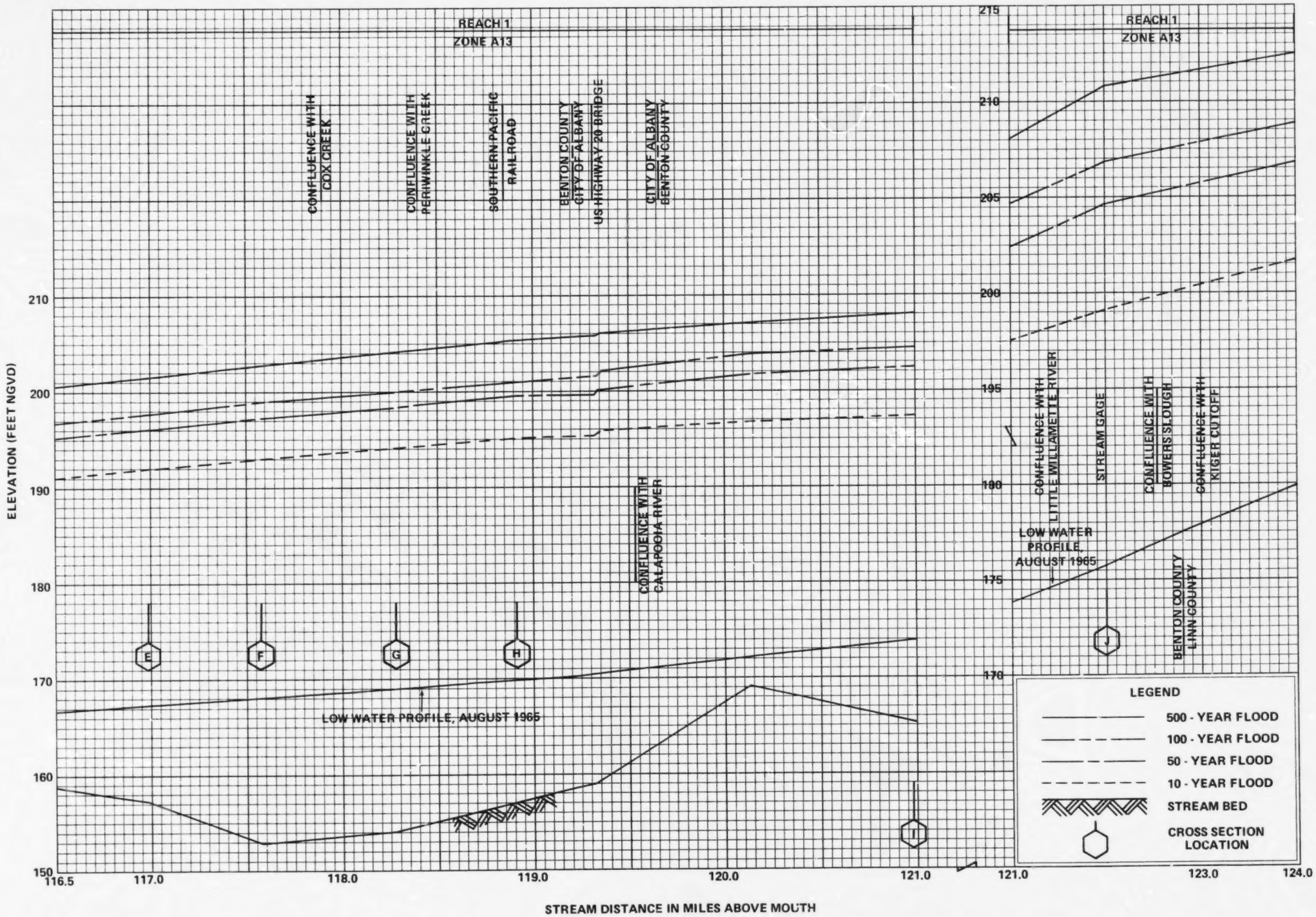

FLOOD PROFILES

WILLAMETTE RIVER

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BENTON COUNTY, OR
(UNINCORPORATED AREAS)

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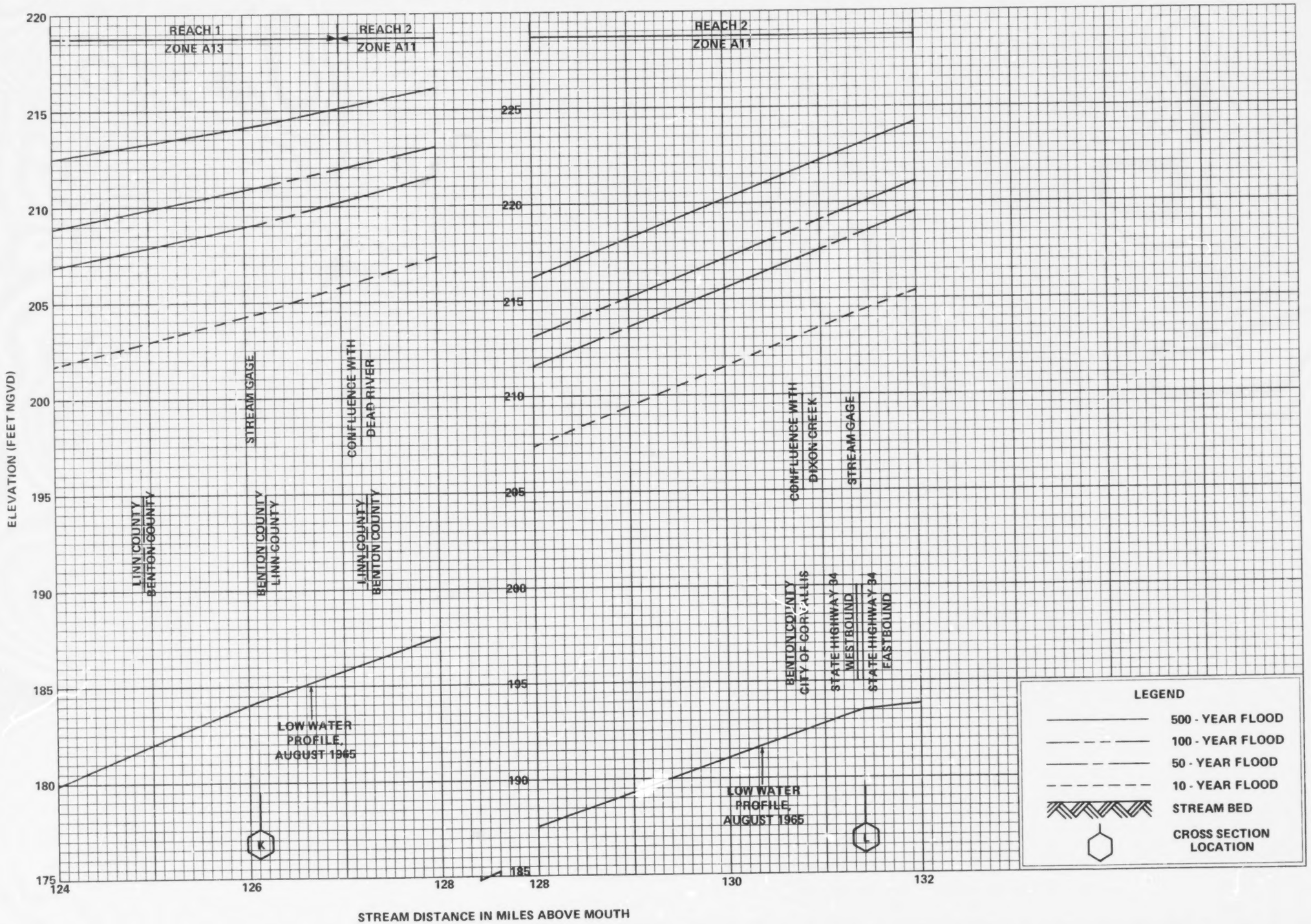

FLOOD PROFILES

WILLAMETTE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

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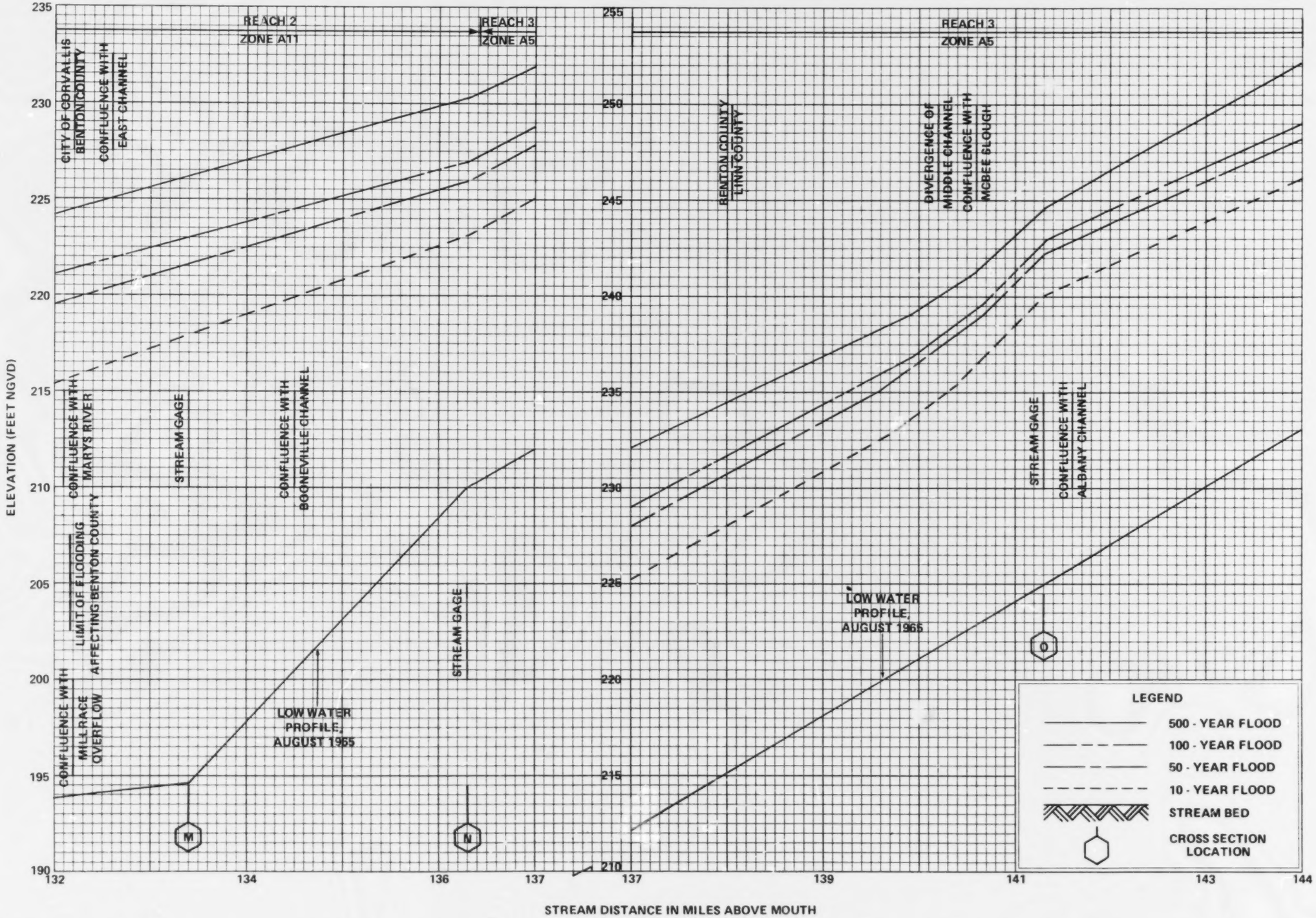

FLOOD PROFILES

WILLAMETTE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

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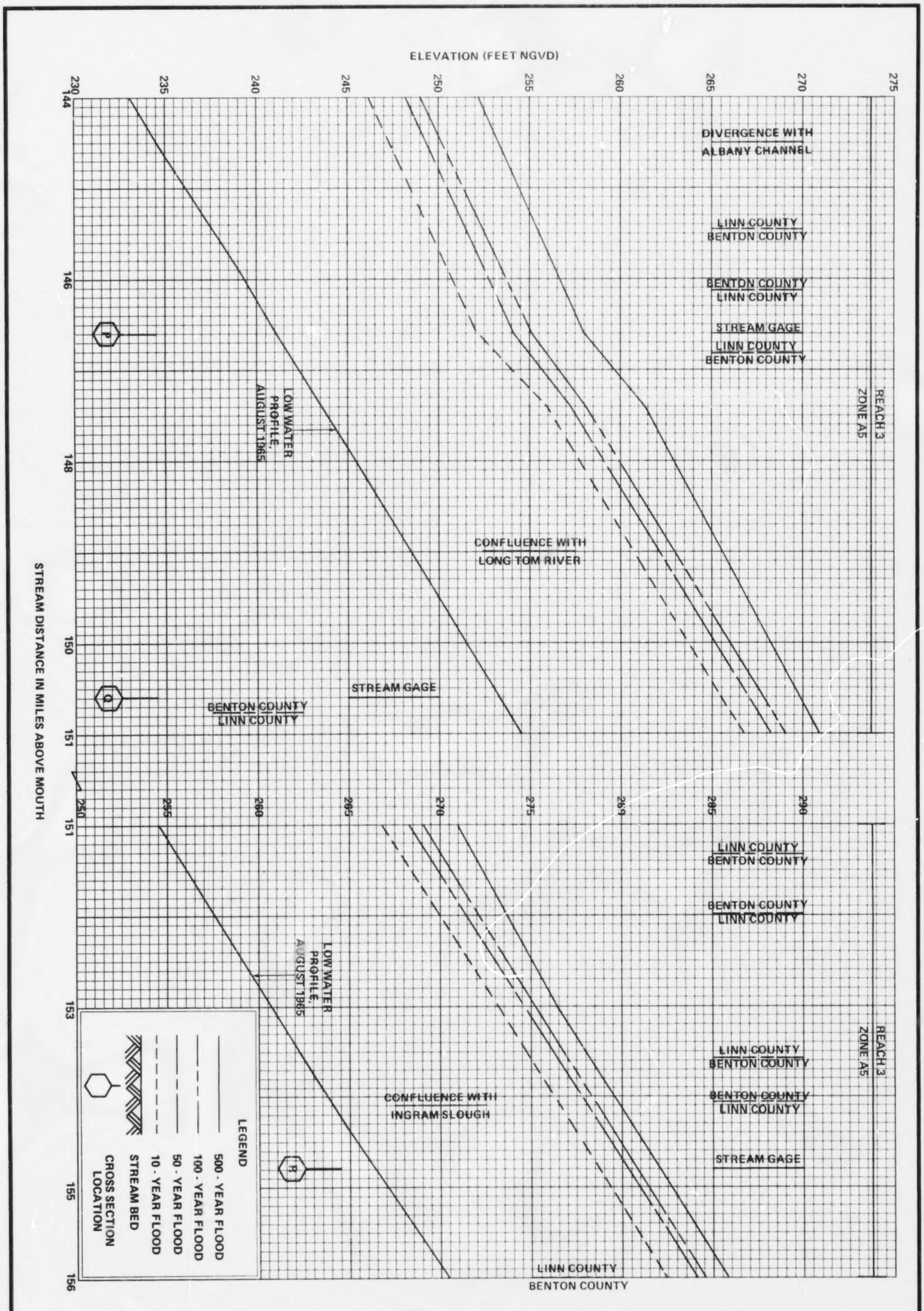

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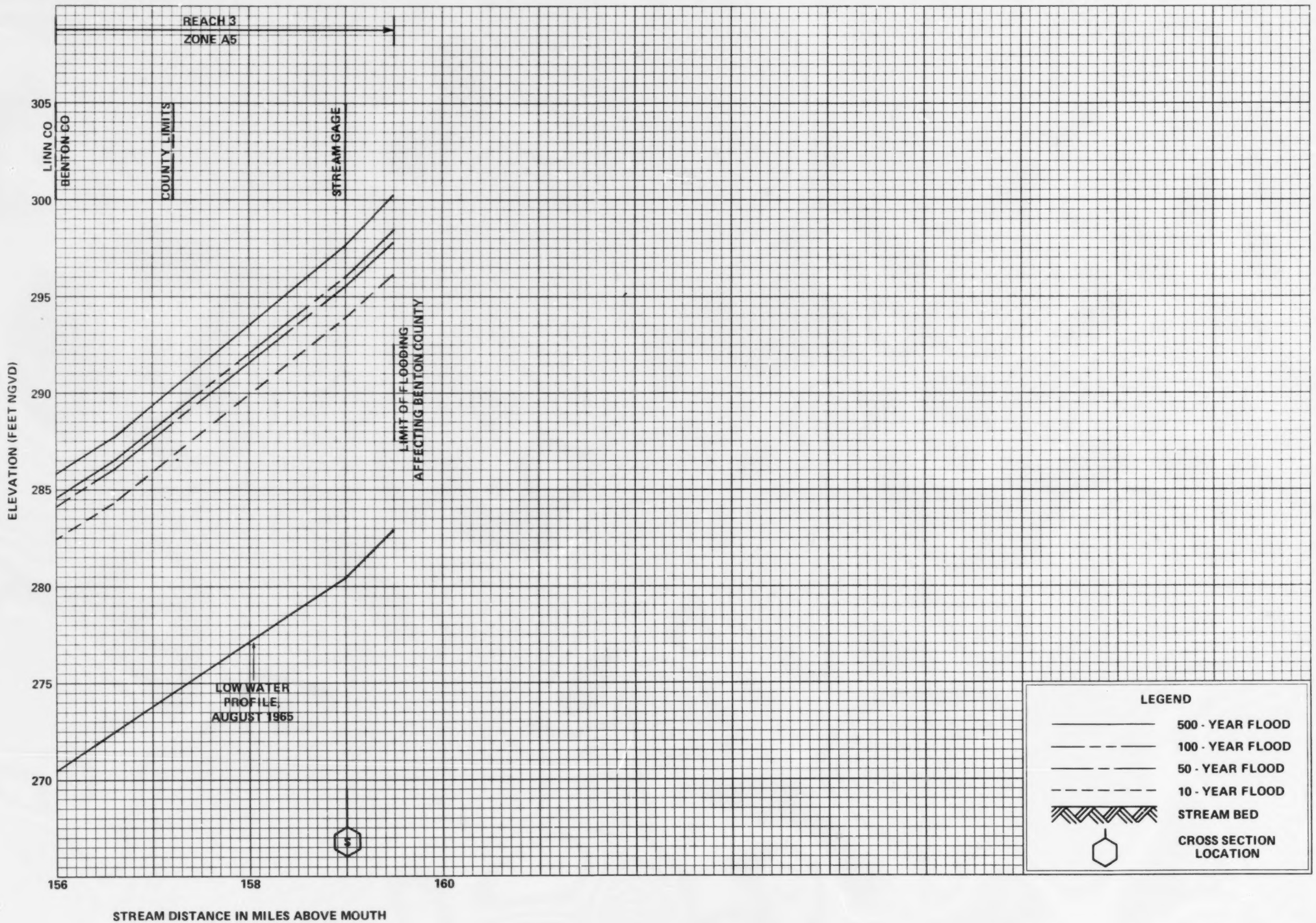

FLOOD PROFILES

WILLAMETTE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

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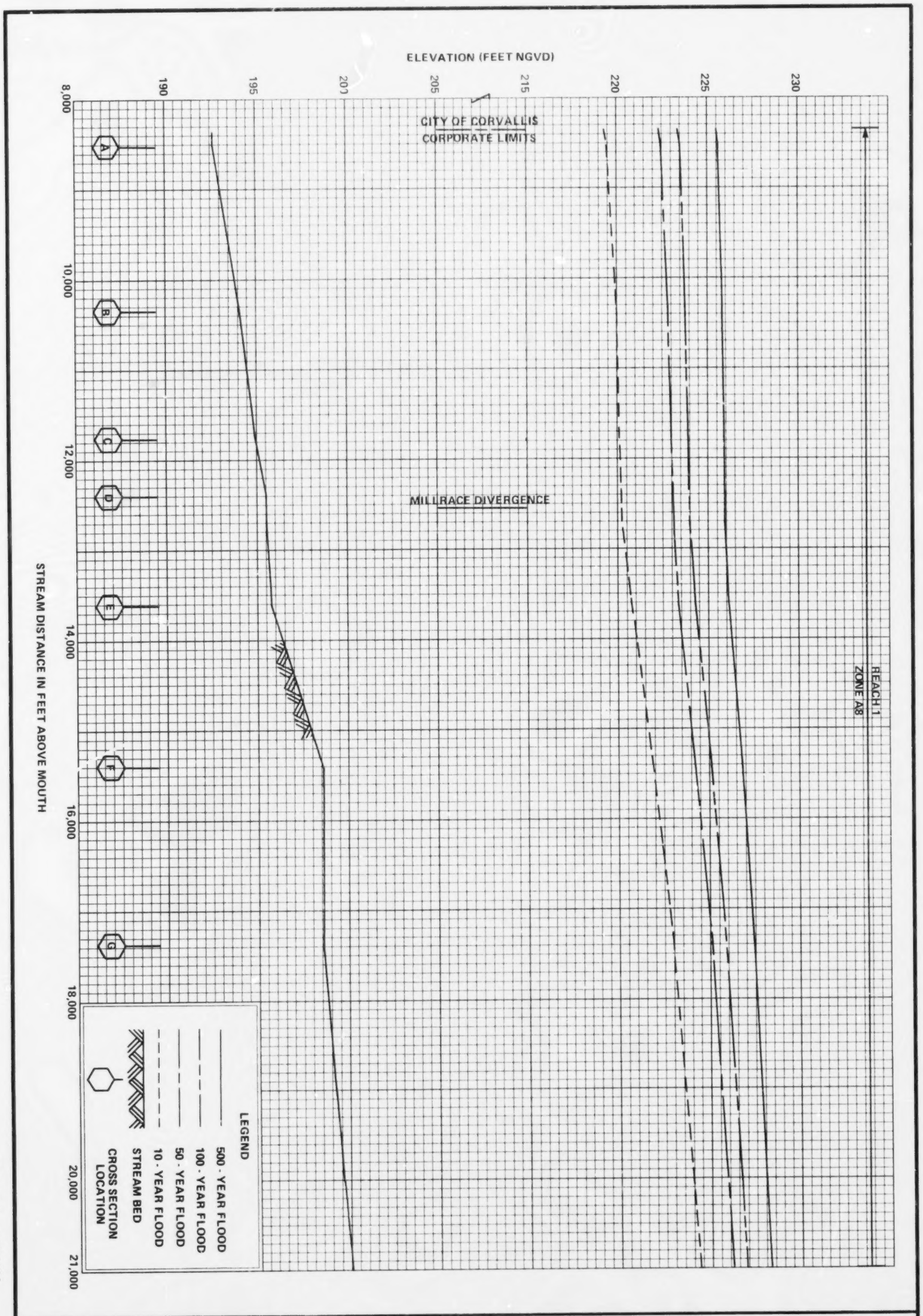

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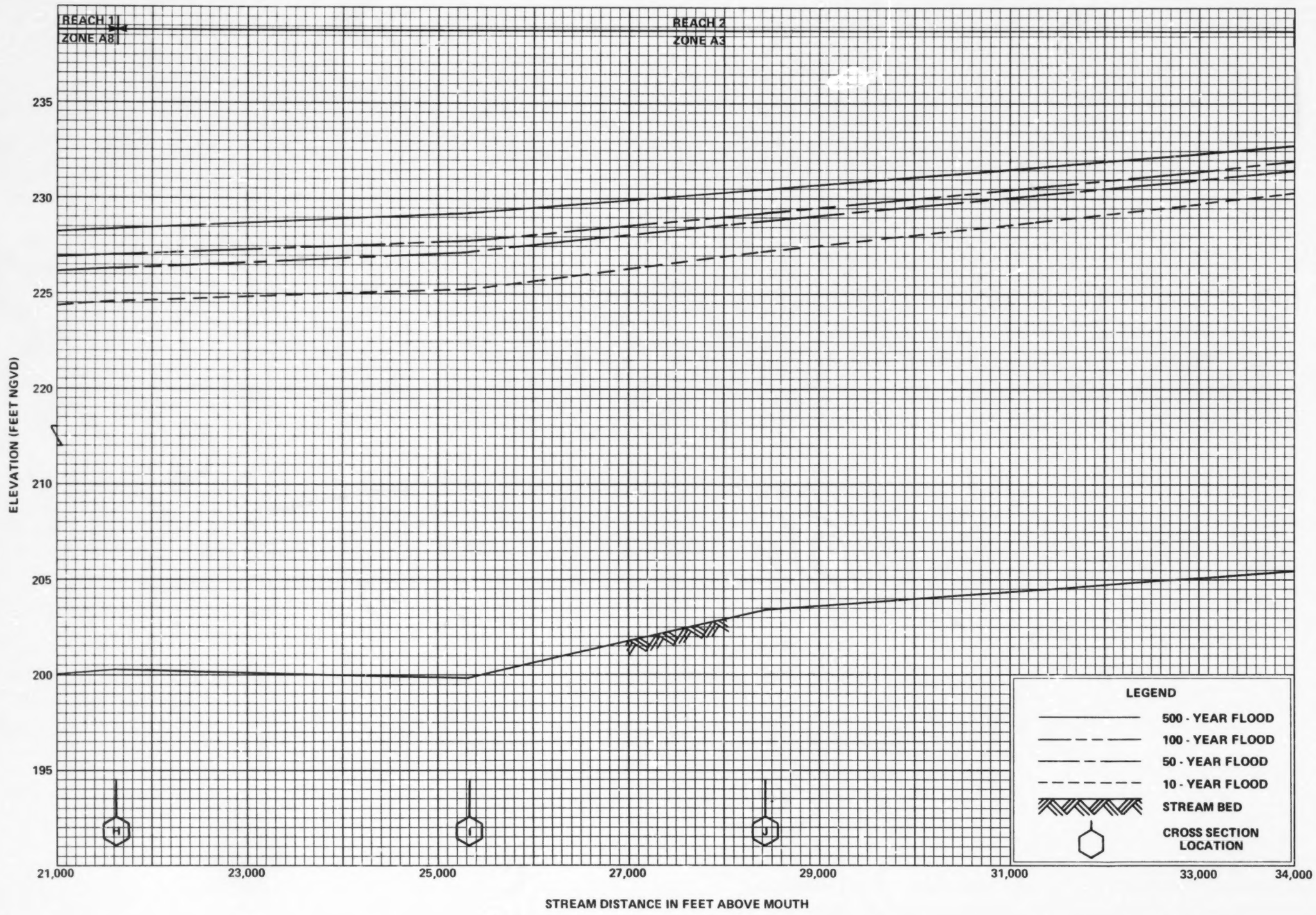

FLOOD PROFILES

MARYS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

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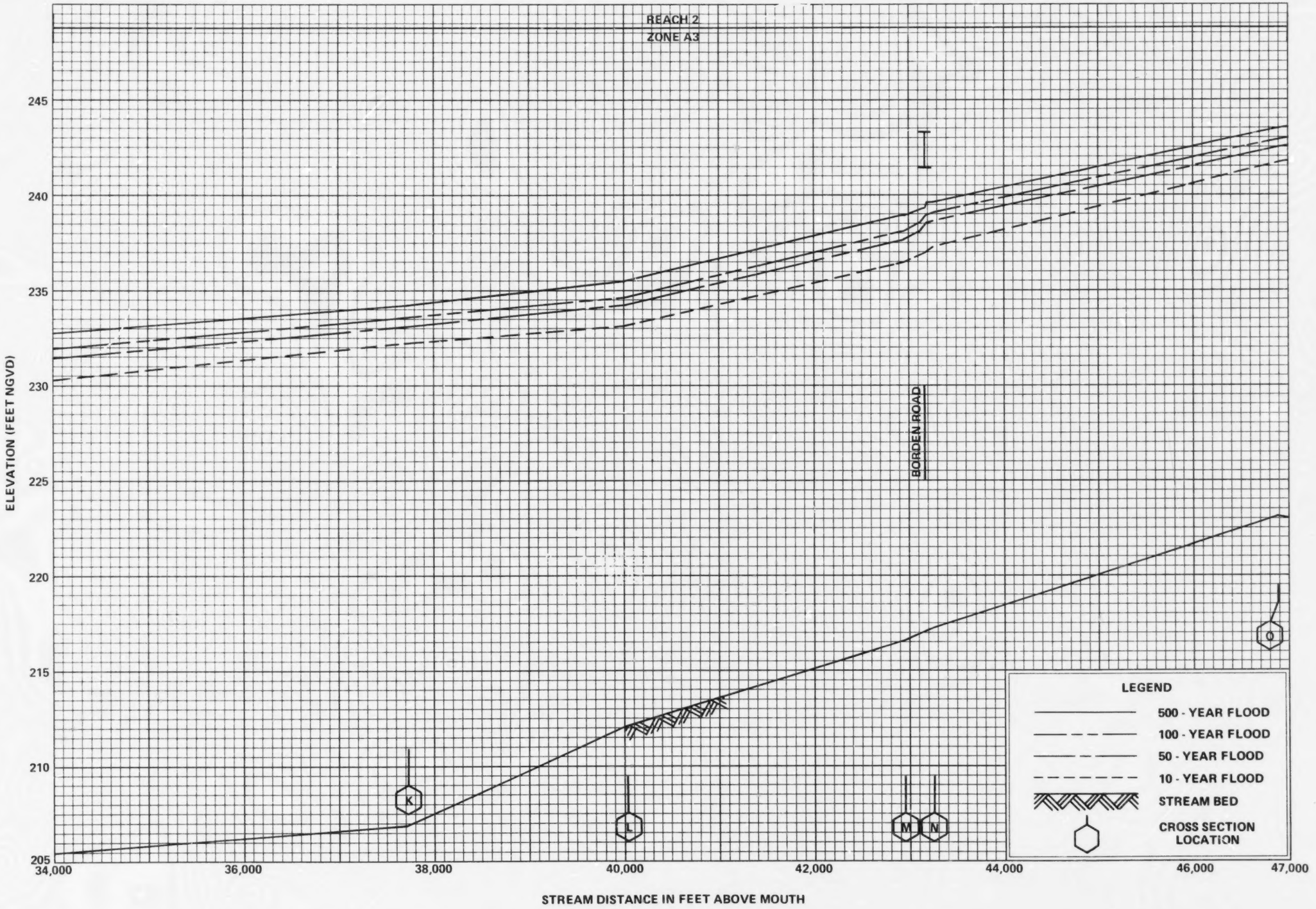

FLOOD PROFILES

MARYS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

09P

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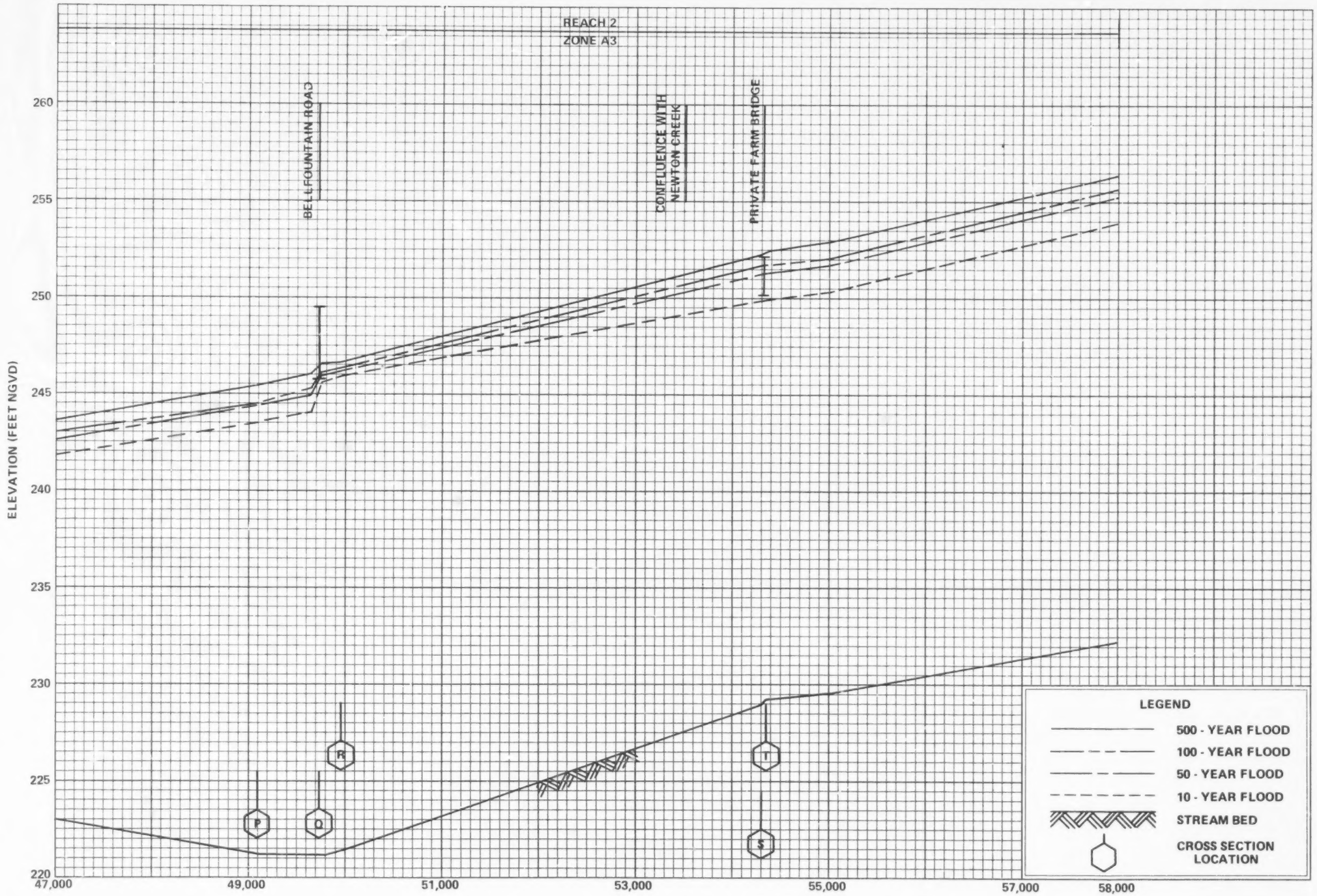

FLOOD PROFILES

MARYS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

10P

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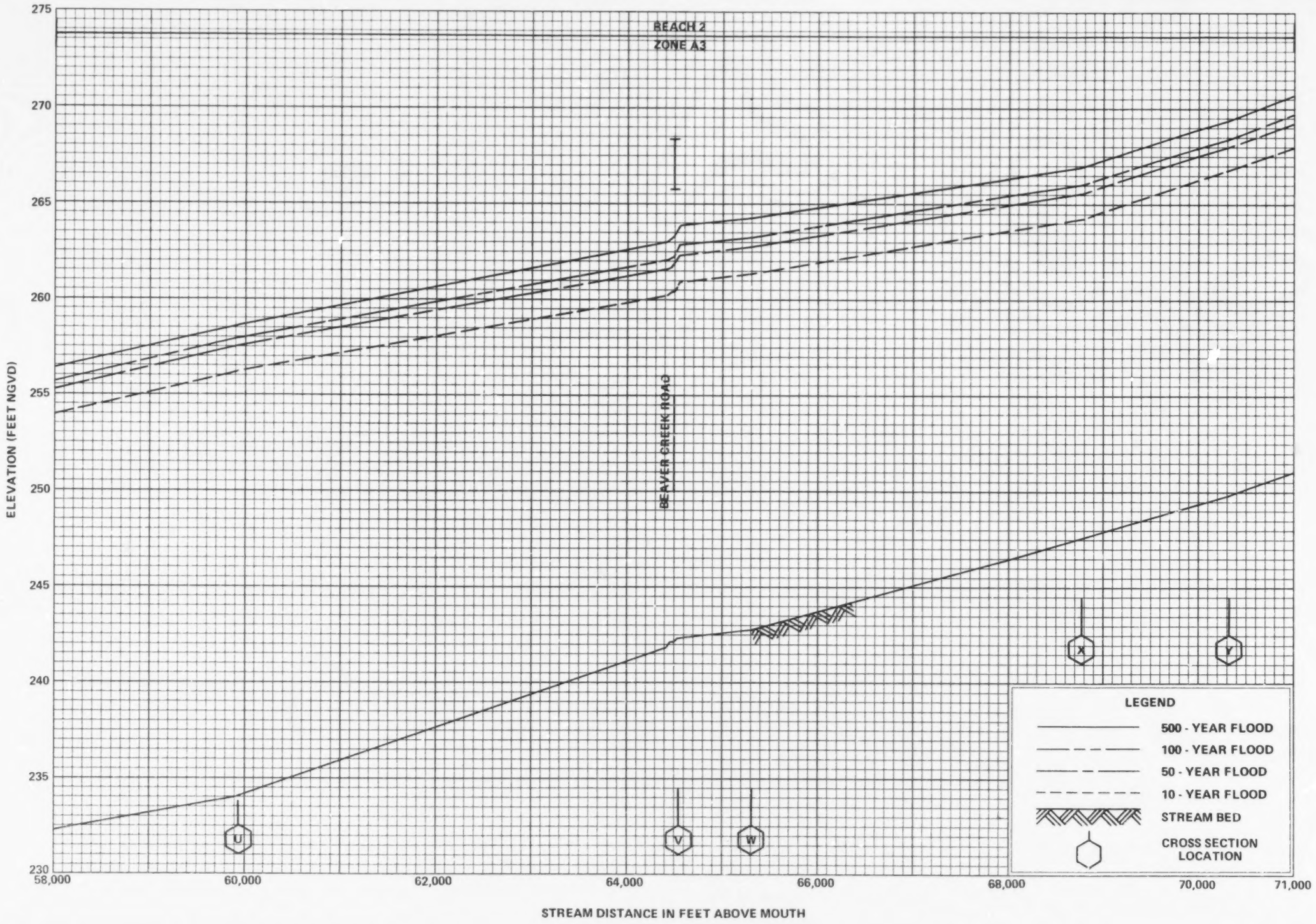

FLOOD PROFILES

MARYS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

11P

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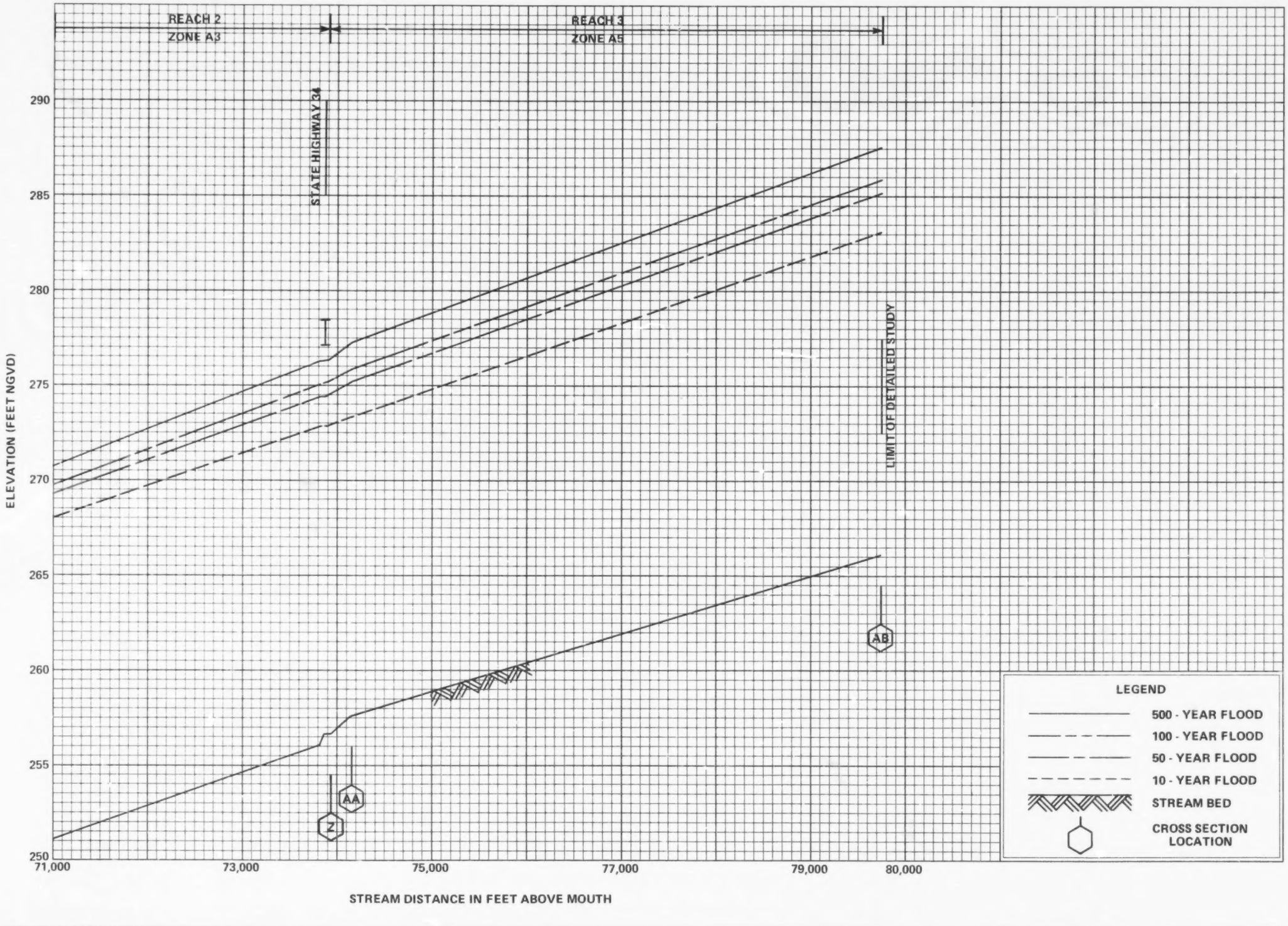

FLOOD PROFILES

MARYS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

12P

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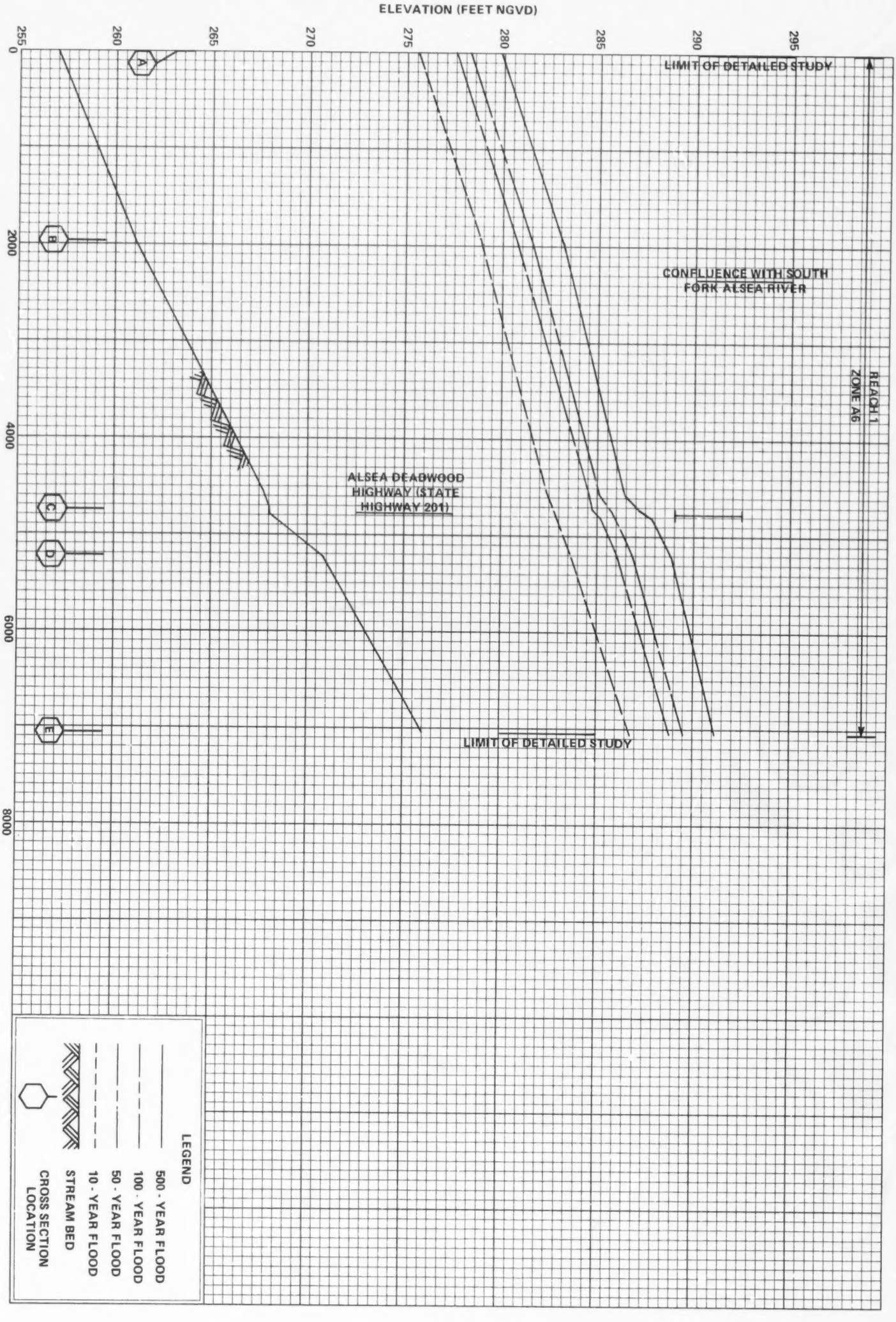

13P	FEDERAL EMERGENCY MANAGEMENT AGENCY BENTON COUNTY, OR (UNINCORPORATED AREAS)	FLOOD PROFILES NORTH FORK ALSEA RIVER

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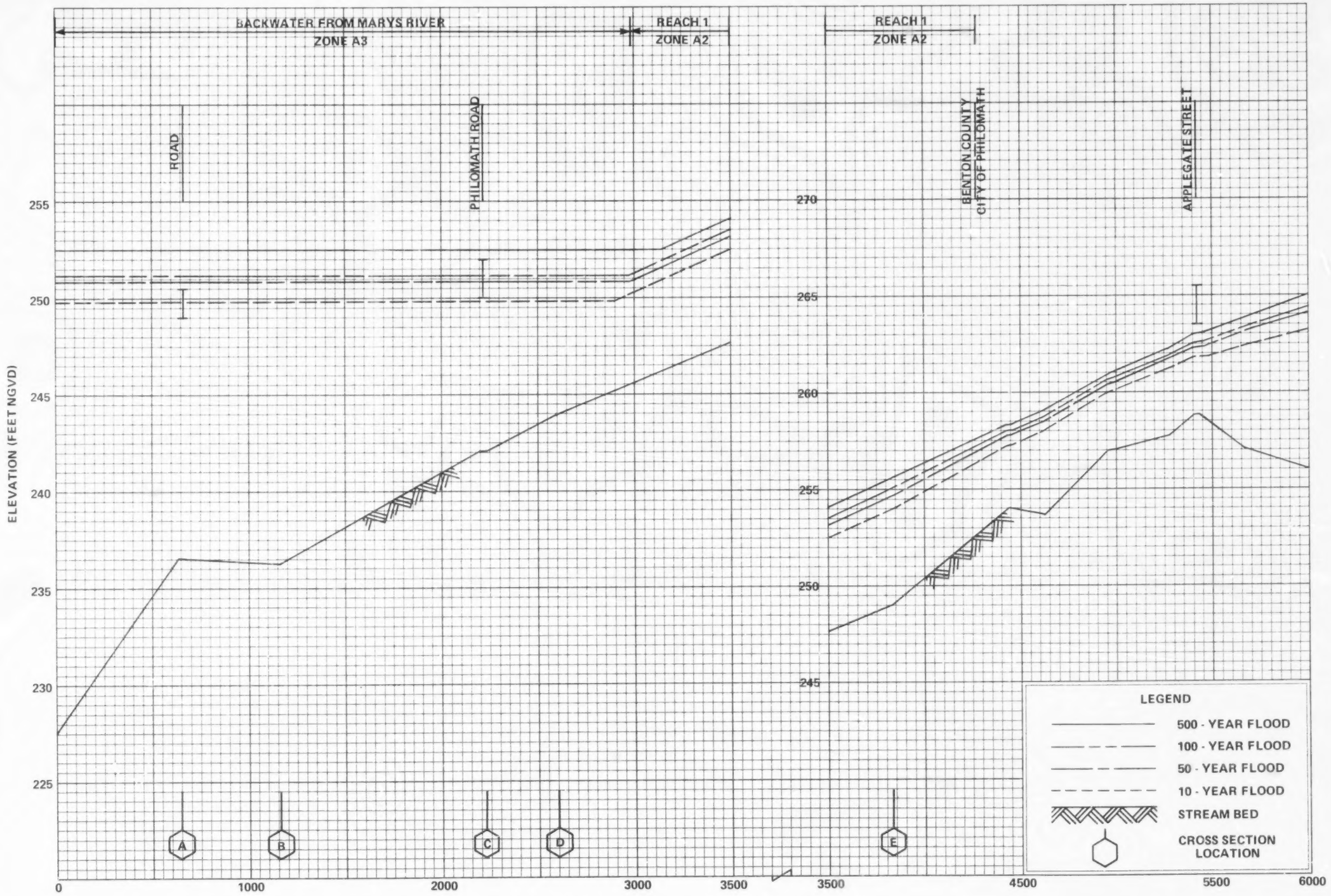

FLOOD PROFILES

NEWTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

14P

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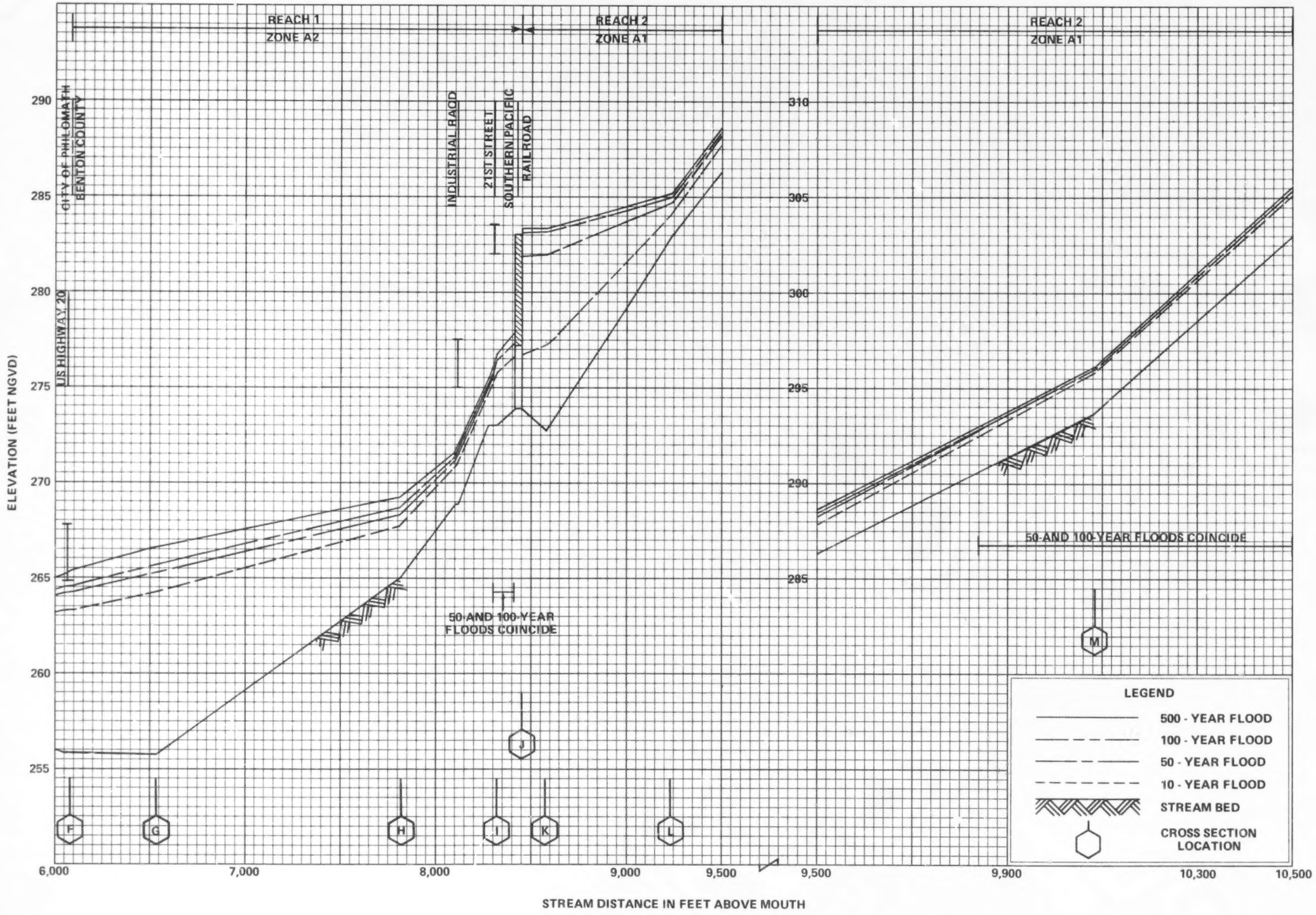

FLOOD PROFILES

NEWTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

15P

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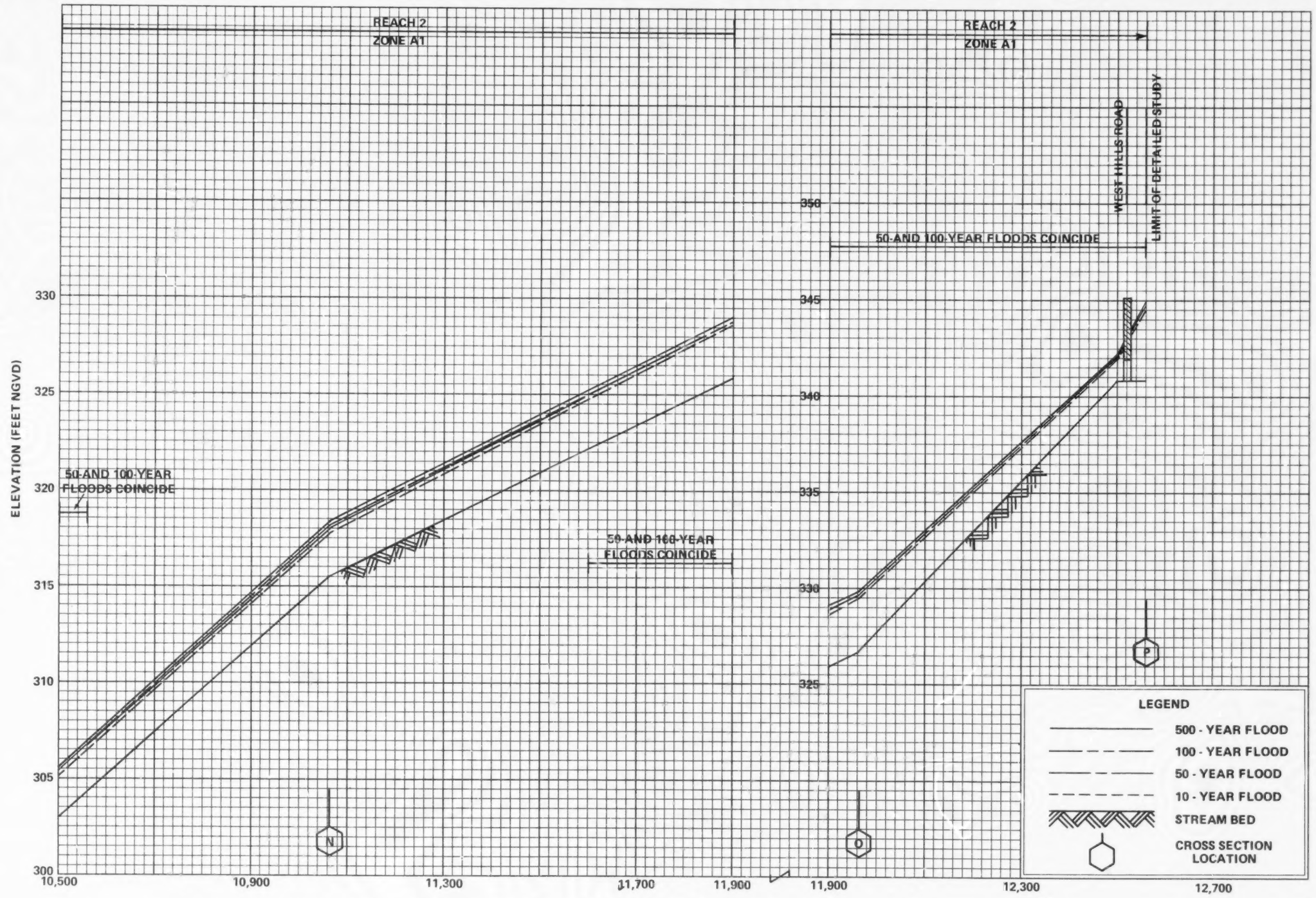

FLOOD PROFILES

NEWTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

16P

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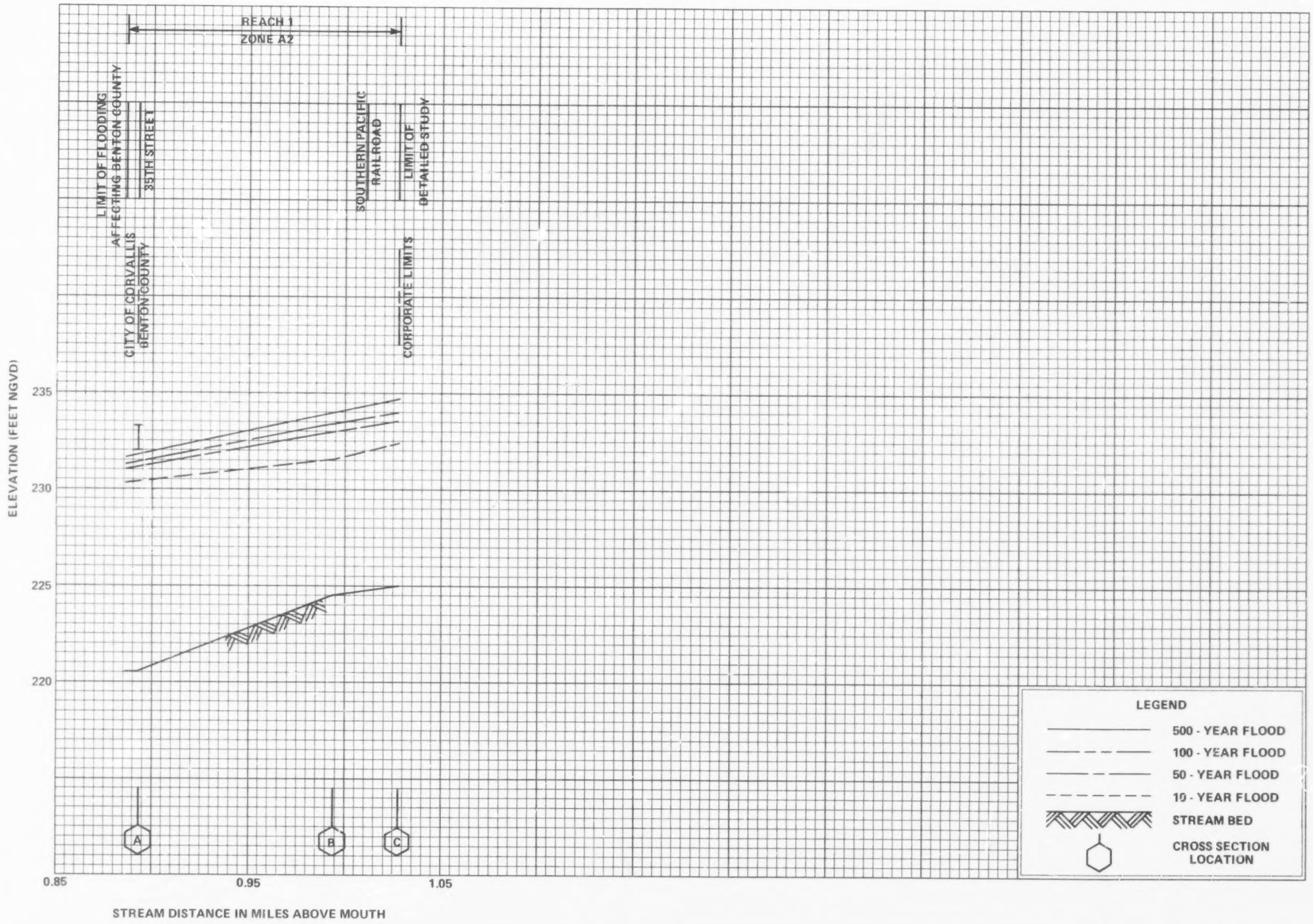

FLOOD PROFILES

OAK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

17P

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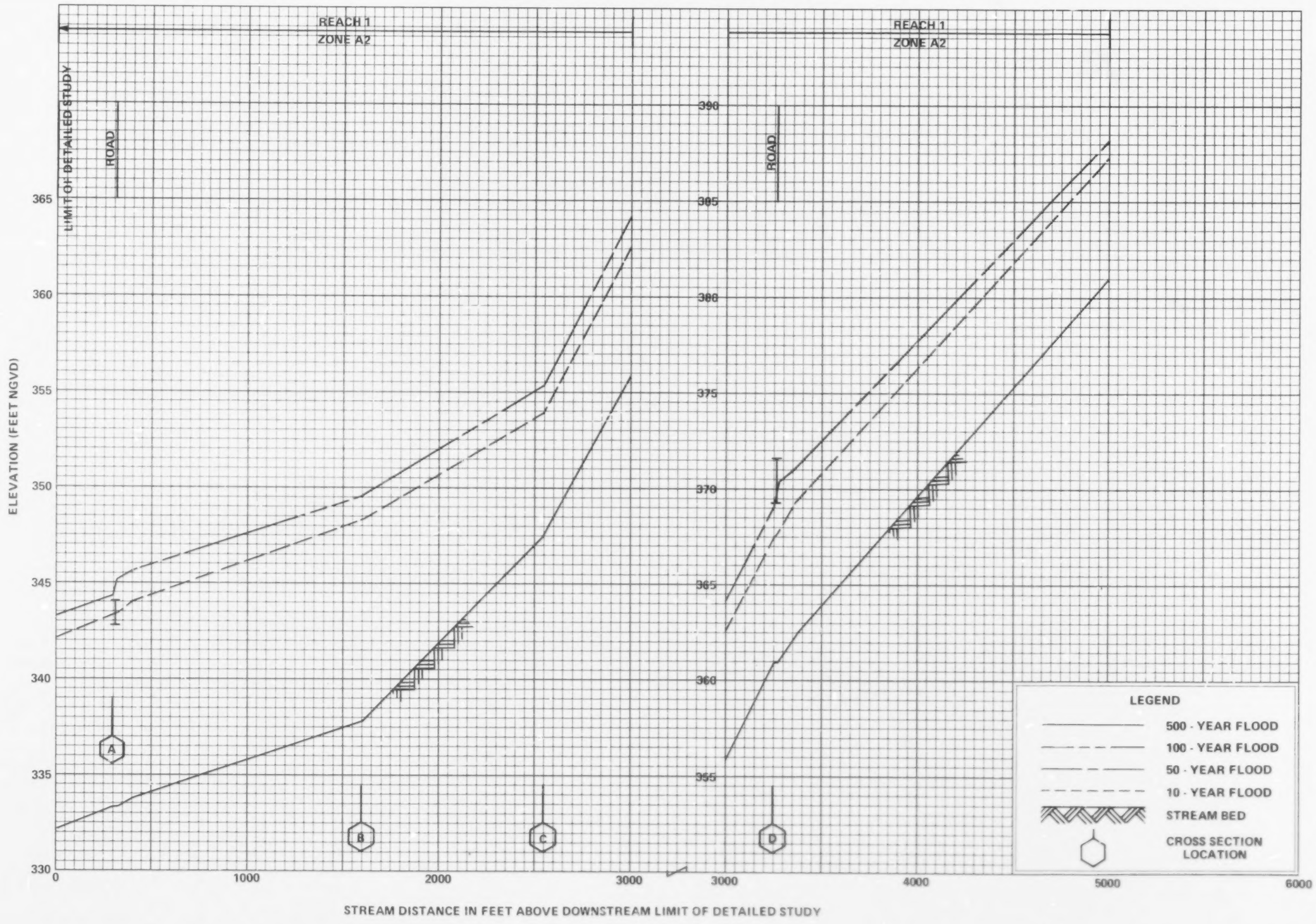

FLOOD PROFILES

SOAP CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

18P

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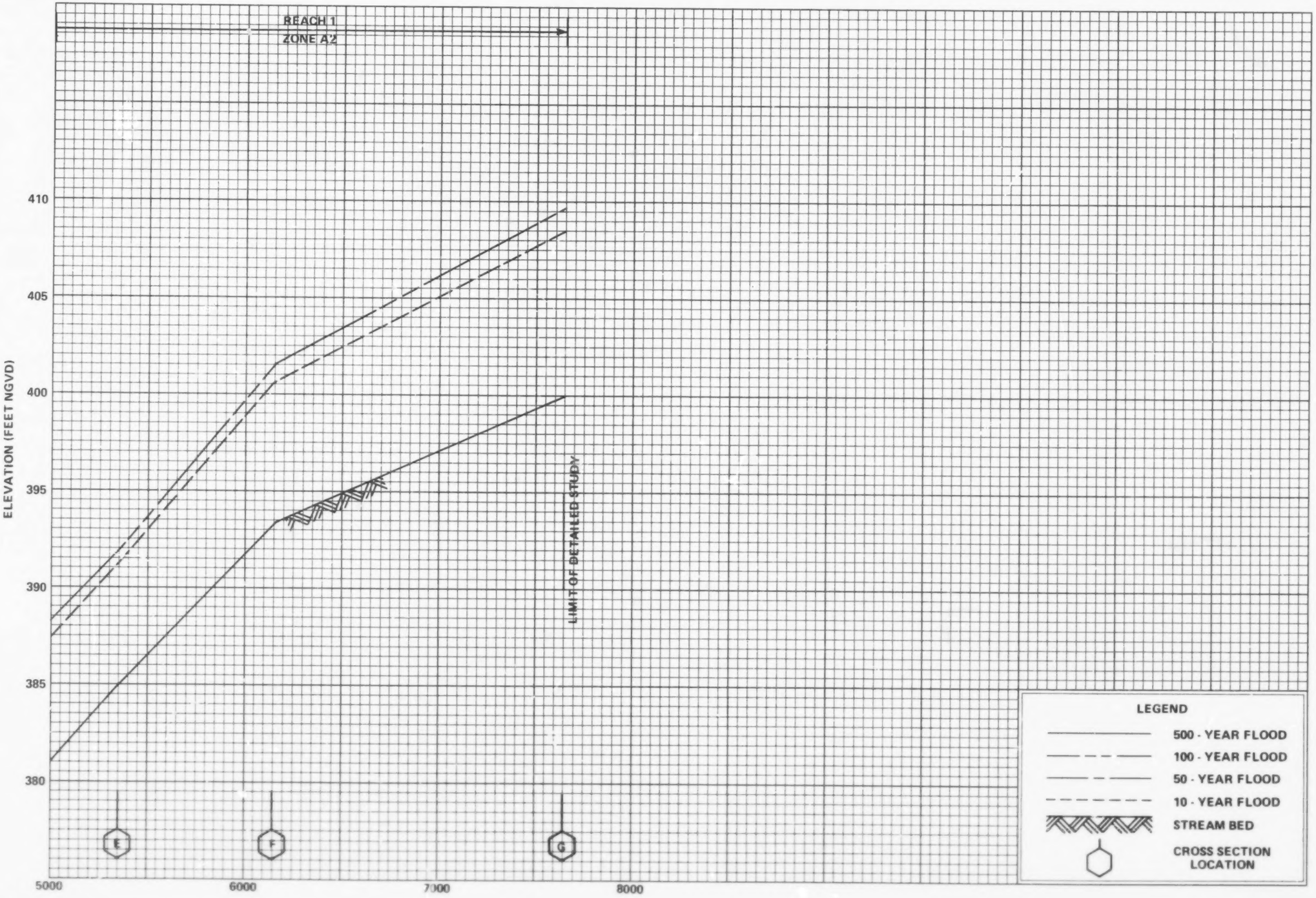

FLOOD PROFILES

SOAP CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

19P

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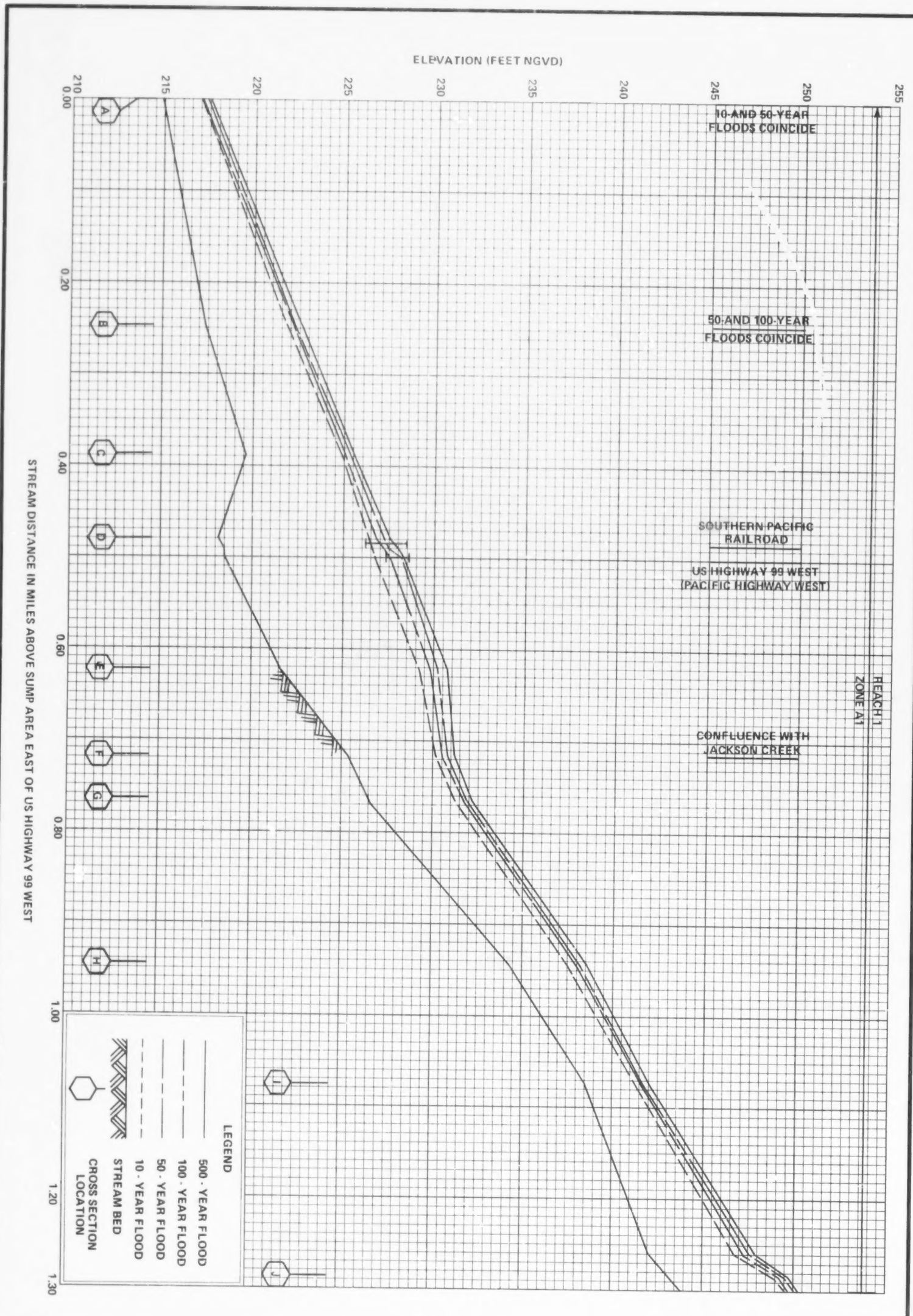

52

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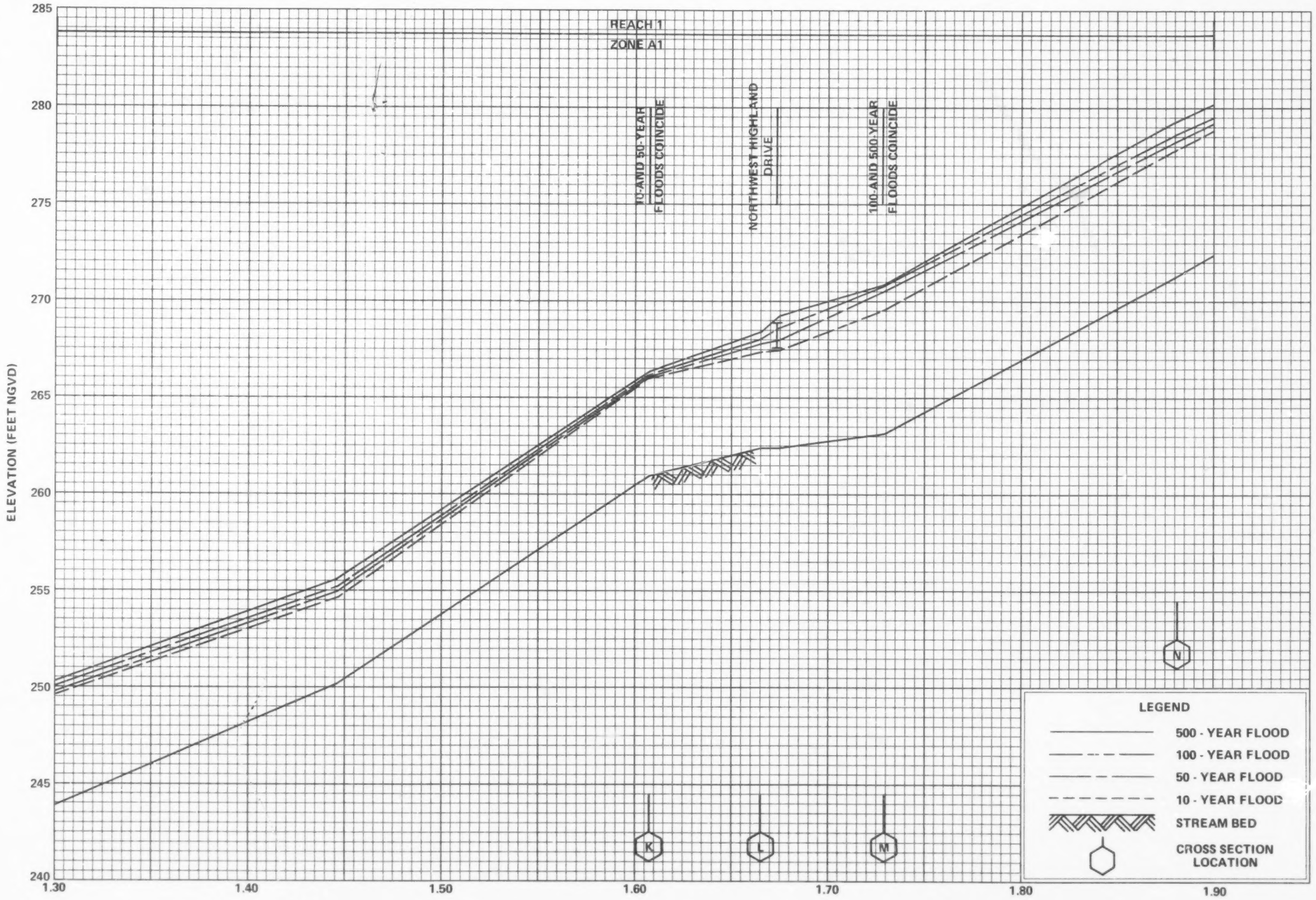
20P

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

FLOOD PROFILES

FRAZIER CREEK



FLOOD PROFILES

FRAZIER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

21P

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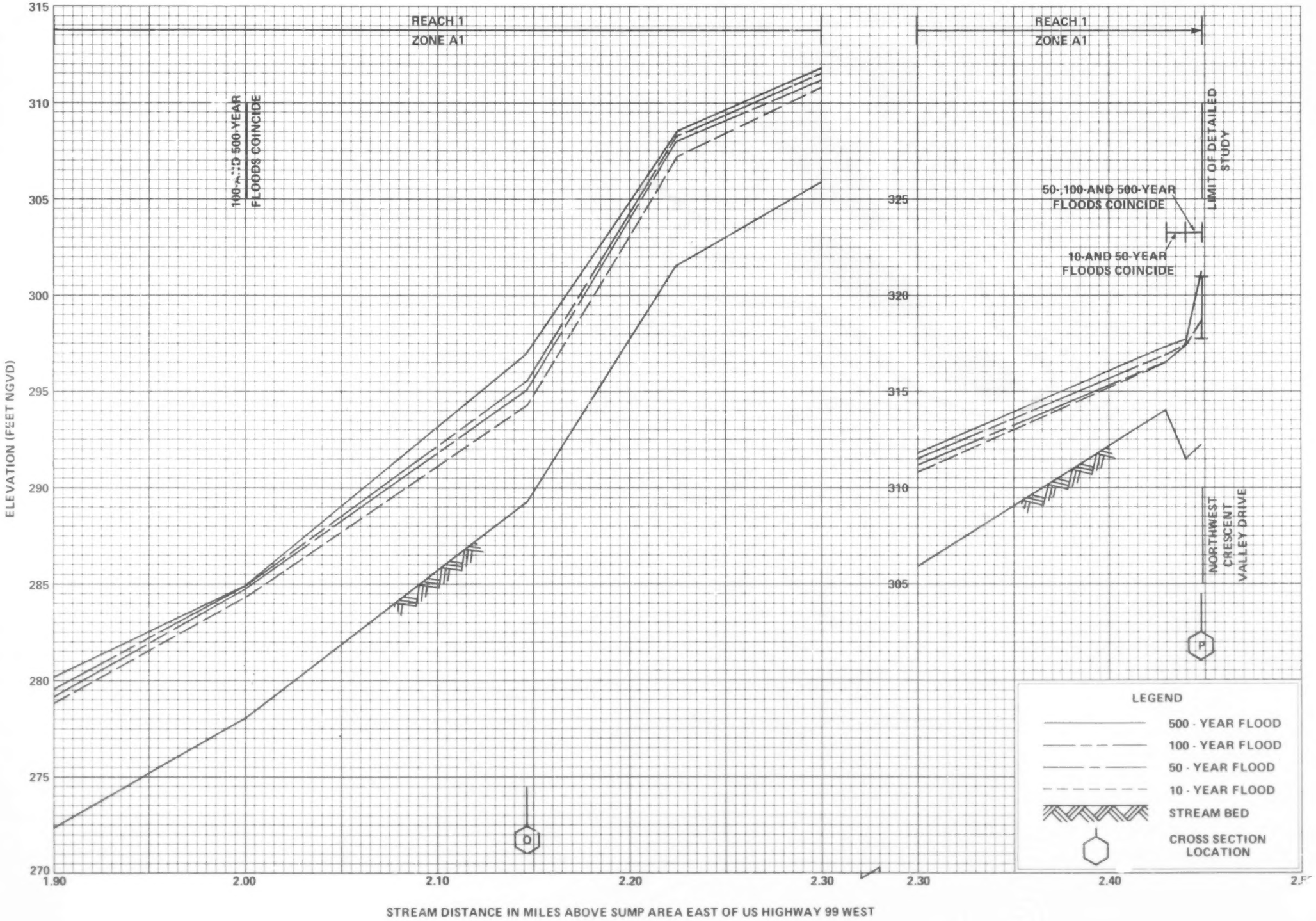

FLOOD PROFILES

FRAZIER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

22P

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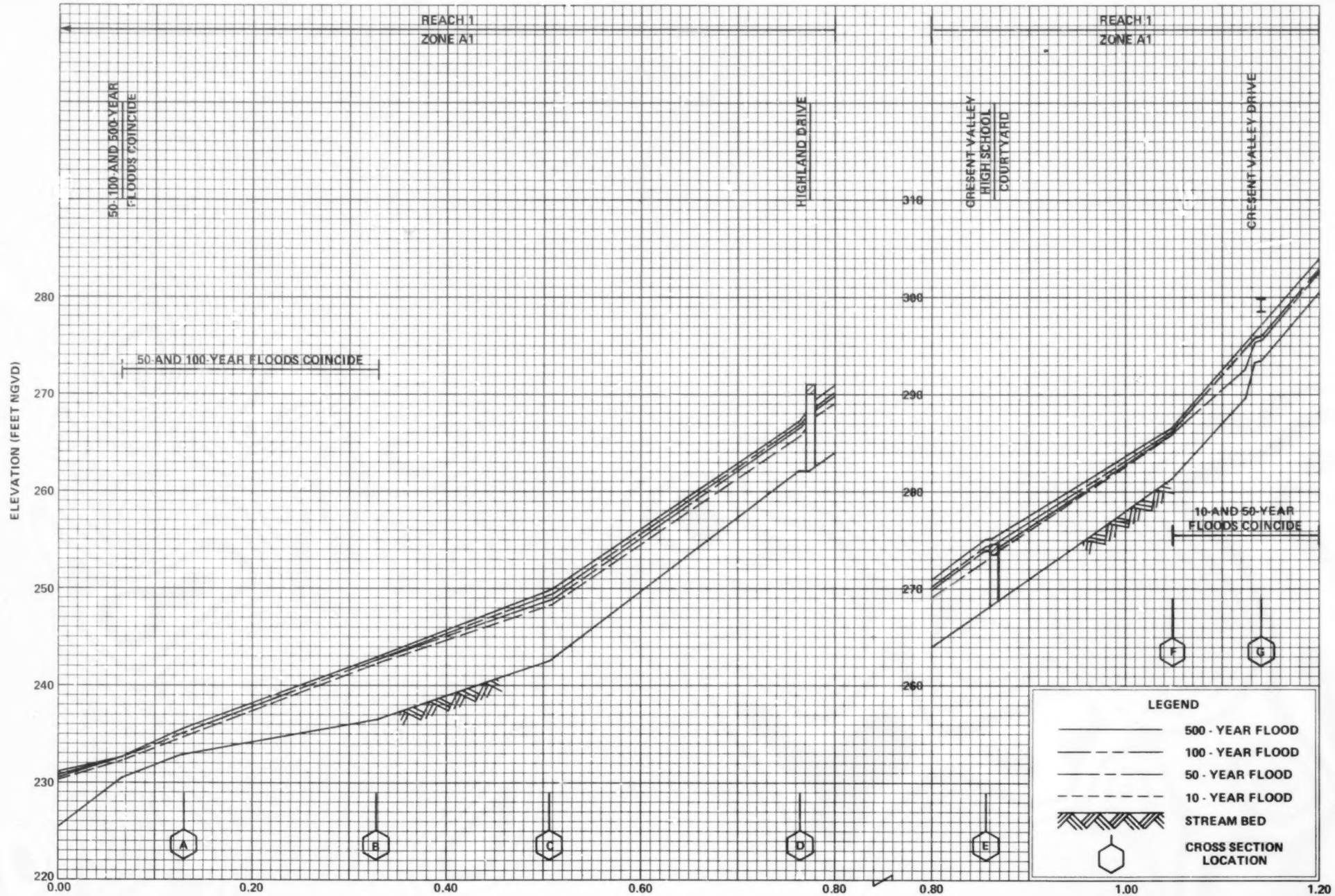

FLOOD PROFILES

JACKSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

23P

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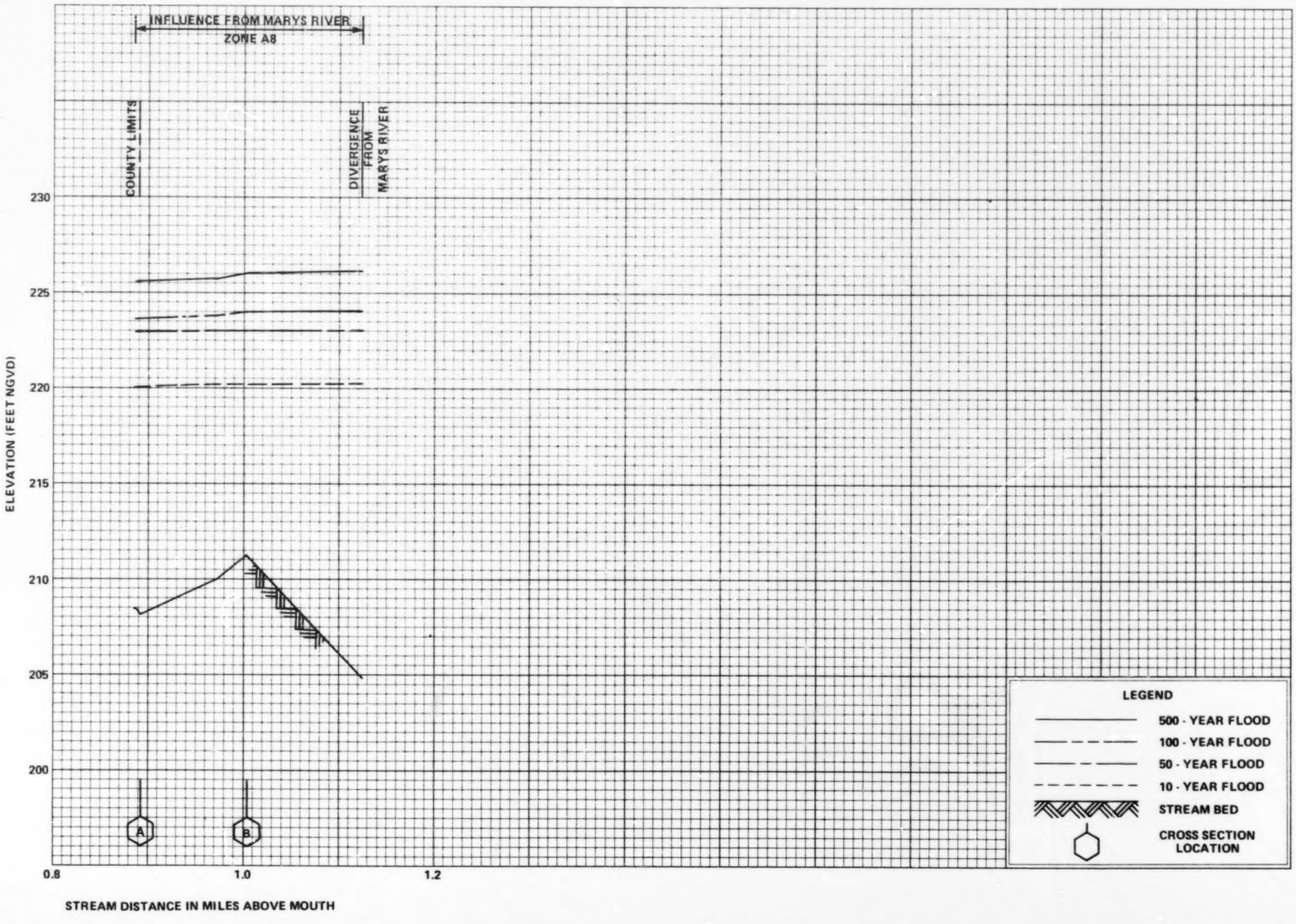

FLOOD PROFILES

MILLRACE

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

25P

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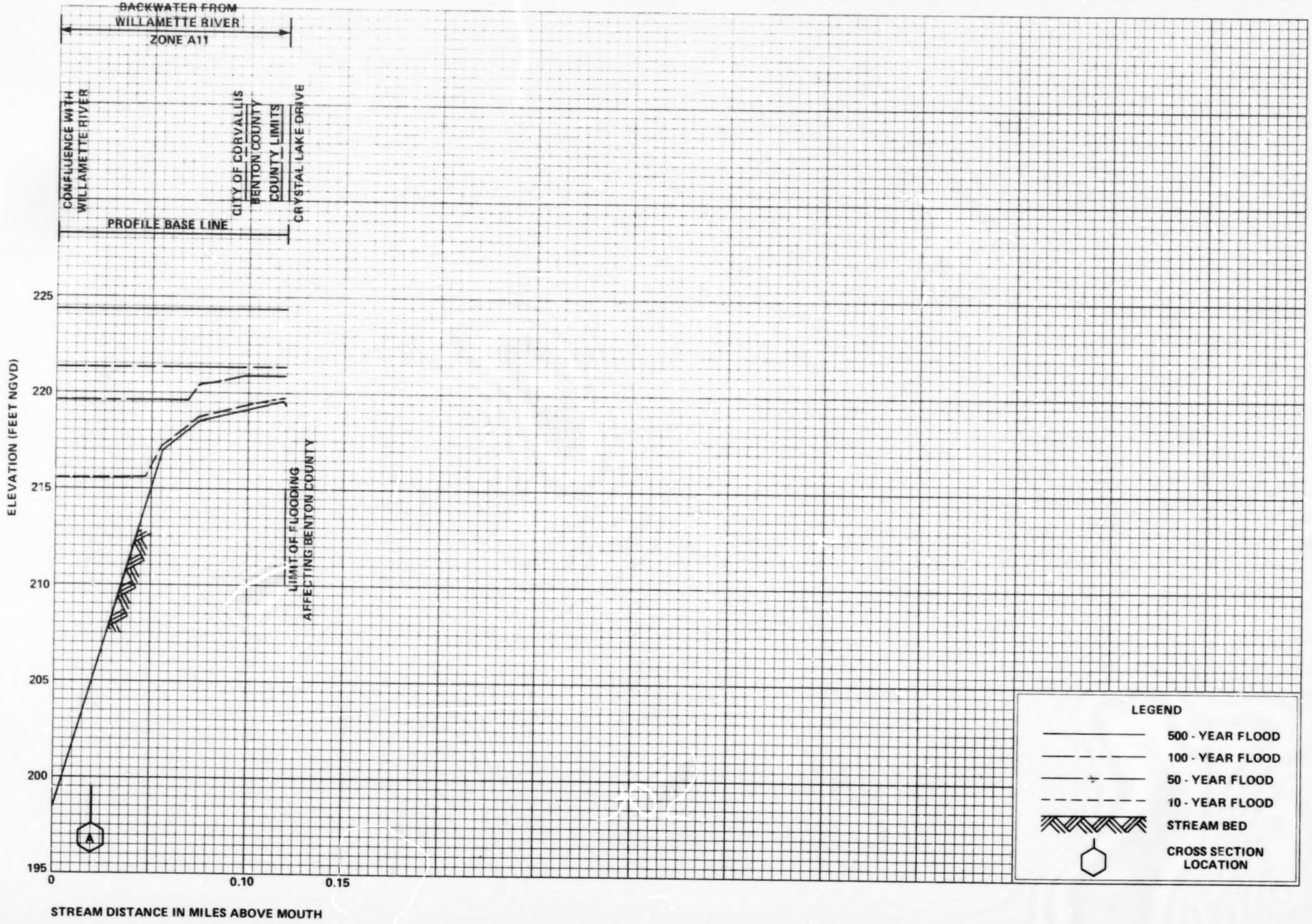

FLOOD PROFILES

MILL RACE OVERFLOW

FEDERAL EMERGENCY MANAGEMENT AGENCY

BENTON COUNTY, OR
(UNINCORPORATED AREAS)

26P

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